The Dictator's Inner Circle

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Abstract

We posit the problem of an autocrat who has to allocate access to executive positions within his inner circle and define the career profile of his insiders. The leader monitors the capacity of staging a coup by his subordinates and the incentives of trading a subordinate's own post for a potential shot at the leadership. These theoretical elements map into structurally estimable hazard functions for ministerial terminations in African governments. The evidence points at leader's survival concerns playing a crucial role in shaping the incentives of insiders within African national governments and can ultimately help explain insiders' widespread lack of competence and nearsighted policymaking in autocracies. Several counterfactual policy experiments are performed.

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1 Introduction

Modern African economic history is replete with political failure (Herbst, 2000). Part of it has been ascribed by frequent observers to a political class that is both rapacious and myopic[1], much resembling the roving bandits à la Olson (2000) or the African predatory officials described by Shleifer and Vishny (1993). This paper shows how the very nature of the threats to national leaders arising from government insiders may be an essential part of the problem.

This paper focuses on powerful insiders, in positions of national prominence such as national cabinet posts, and on the political survival of members of this inner circle in a panel of sub-Saharan African (SSA) countries.[2] Using data on these individuals, we provide a unique perspective on the internal organization of autocratic regimes in the continent. This is particularly important given the natural opacity of the autocratic regimes.

In Section 2 we begin by uncovering a novel set of stylized facts based on a newly collected data set featuring the annual composition of national cabinets in a large set of SSA countries. First, we show that leaders with more experience in government (in terms of number of years in which they were observed in past executive positions before taking office as leader) tend to hire ministers with more experience (again proxied by number of years in previous cabinets). We also report novel regularities concerning the survival in office of both SSA leaders and ministers, showing that for both groups hazard rates are time varying. While leaders face decreasing hazards of termination over time, extending earlier work by Bienen and Van De Walle (1989), SSA ministers face initially increasing termination hazards over time under a given leader. Only after a specific number of years in government do the termination hazards drop.

We provide a theoretical framework able to reconcile these stylized facts parsimoniously.

[1]For an early discussion see Bates (1981).

[2]See Arriola (2009), Burgess et al. (2011), Rainer and Trebbi (2011) and Francois, Rainer, and Trebbi (2015) for a discussion of the role of national posts as prominent sources of political patronage playing a key role in prebendalist societies like the ones we study.

Section 3 focuses on the problem of a leader selecting and terminating government insiders based on the time his subordinates have spent inside the 'palace'. Statically, we posit that more experienced ministers (i.e. insiders endowed with longer past experience in government and more political capital at the onset) are able to produce more value for a leader, but are also more apt at capturing a larger share of that value. Dynamically, time spent inside the palace increases the capacity for ministers to become a serious threat to the leader. The emergence of such internal threats are identified in the literature on sub-Saharan African politics as perhaps the paramount concern facing leaders. Insiders have the potential of becoming "*rivals [...] developing their own power base*" (Bratton and Van De Walle, 1994, p.463). As a consequence, a leader will tend to terminate ministers if they become too much of a threat and this increasingly more over time, as they learn their way through the government organization. In the words of Soest (2007 p.8) African leaders uproot ministers from their current posts "*in order to prevent any potential opponent from developing his or her own power base*". Indeed, the literature has often ascribed the "*ministerial game of musical chairs*" (Tordoff and Molteno 1974 p. 254) to this goal. Examples of leaders following such strategies abound. Mobutu Sese Seko ruled the Democratic Republic of the Congo for thirty years and frequently rotated ministers in to and out of office, and sometimes in to jail or worse, see Leslie 1993, based on perceived coup threats. Jean-Bedel Bokassa in the Central African Republic followed an extreme form of shuffling – as often as six times per year (Meredith 2005, p. 225) – to preempt the formation of power centres that could come to challenge him. A recent example is the shuffle of ministers undertaken by Cameroon's president Paul Biya. According to the Cameroon Concord: "The shuffle therefore is very much about Paul Biya and his desire to silence any potential threat to his regime of personal power."[3]

Of course, coups do not arise only from ministers, as they also rely on elements of the military to take effect. But it is rarely the case that such coups take place without the

[3]See http://cameroon-concord.com/op-ed/item/4292-cameroon-government-shuffle-in-president-biya-s-interest-not-the-peoples.

complicity of important civilian insiders like ministers. Our model features leaders who are aware of this, carefully monitoring regime insiders and dismissing those they fear becoming too powerful. A similar process of purging and shuffling of high ranking military officers is also known to occur in such regimes, but this aspect of the problem is not analyzable with our data set, so we include purely military threats as one of a set of residual dangers that affect regime stability but that are not within the control of the leader. Though we don't model the source of these residual threats, their inclusion is important. It will be seen that their time pattern, gleaned from the data, interacts with and affects the timing of cabinet specific threats that are our primary focus.

The capacity to stage coups increases monotonically over time, but a minister's desire to do so is a function of both the leader's and minister's length of time in office. Specifically, each leader reaches a point in time after which, even when given the opportunity of staging a coup, a minister under him will not take it and will remain loyal. Such a point arises because ministerial value increases with the experience of both leader and minister. As their experience accumulates, the minister eventually comes to prefer the relatively stable ministerial post to the opportunity of establishing his own new (but fragile) regime by deposing the leader. At the point where this occurs (what we term the 'safe date') the hazard function for ministers discretely falls, and remains low until the end of the leader's tenure. Our theoretical model thus shows that the joint leader considerations of value maximization and security can generate the observed hump shaped hazard function for ministers, but that it does so in a very particular way; i.e., via the existence of a leader specific safe date.

Taking just the safe date aspect of the model seriously, we then see whether a decomposition of ministerial hazards predicated on the leader specific safe dates can generate hazards that are consistent with the model's predictions. That is, we check whether the observed hump shaped hazards for ministers in the data are generated by an underlying mechanism that depends on where the leader is relative to a posited safe date. We find that it does. This hump shape for individual ministers can be decomposed into two parts. The data exhibits an increasing hazard for ministers working under a leader that is relatively new, followed by a decreasing hazard generated by working under leaders with long experience. Thus this reduced form decomposition exercise shows that the overall hump shaped hazard observed for ministers in the raw data arises from a convolution of ministers hired before leader safe dates with those hired beyond them.

Finding a match to the data is not surprising per se; our model is built in order to meet the non-monotonic hazard for ministers which our data exhibits. But a decomposition of ministerial hazards along the precise lines predicted in the model for leader experience is. There are other models able to generate non-monotonic hazards that can be applied from the labor economics literature. In comparison to these, we believe that a prima facie advantage of our model is that it is informed by the peculiar microeconomic considerations, namely the paramount issue of leader security, that the literature highlights in this setting. But despite this, and this reduced form match of the model, an important question to still ask is how well the model 'fits' the data overall? And how well does it fit relative to explanations that have been used to explain non-monotonic hazards in other settings? The rest of the paper tackles these questions.

In Sections 4 and 5 we structurally estimate our theoretical model and obtain parametric hazard functions. The model delivers estimates of the parameters pertaining to the minister-leader bilateral bargaining problem and to the shape of the coup success/coup capacity function. These parameters also imply unique leader specific safe dates, which we can compute for every leader in our sample. The model is extremely parsimonious, with only one regime-specific parameter and one country-specific parameter (all the remaining parameters are fixed across our 15 countries). In Section 6 we contrast our model with alternative models also able to generate hump shaped hazards for ministers, showing how our approach dominates competing theoretical mechanisms. This includes a class of natural alternative explanations based on information acquisition, where, through time, information regarding a minister's type is revealed to leaders. We argue that this class of explanations fails to explain key patterns in the data and is also dominated in formal tests of model fit relative to our theoretical mechanism. In Section 7 we explore counterfactual exercises and welfare implications.

By theoretically linking the survival risk of dictators to that of their ministers, and vice versa, we are able to provide a unified theory of termination risks under autocracy. The implications are of consequence outside the strict confines of cabinet dynamics studied here. The robust evidence of increasing hazard risks of termination for top politicians within African regimes strongly indicates how pressing leaders' survival concerns are. By affecting the time horizons of politicians in power, it is easy to see why myopic predation could be a pervasive feature of SSA polities, possibly trickling down the entire clientelistic chain from ministerial posts to the national bureaucracy, curtailing valued political investment, and ultimately affecting economic performance.[4] In addition, since these survival concerns vary across regimes and weaken over time within the same regime, we provide a novel explanation for the massive variation in performance observed across autocracies (Besley and Kudamatsu, 2008).

This paper speaks to a vast literature on the political economy of development (Bates, 1981) and on the internal organization of weakly institutionalized countries (Tullock, 1987; Wintrobe, 1998; Acemoglu and Robinson, 2005; Bueno de Mesquita, Smith, Siverson, and Morrow, 2003). In particular with respect to Africa, at least since Jackson and Rosberg (1982), the literature has evolved around the study of individual incentives of elites/clients within the complex structure of personal relationships at the basis of neopatrimonial societies.

This paper is most closely related to previous work on the internal organization of autocracies (Geddes, 2003; Gandhi and Przeworski, 2006; Haber, 2006; Besley and Kudamatsu, 2008; Myerson, 2008; Arriola, 2009; Bidner, Francois and Trebbi, 2014) and from a theoretical standpoint to recent research on incentives of dictators in selecting insiders (Egorov and Sonin, 2011). Relative to Francois, Rainer, and Trebbi (2015), which shares common

[4] See Dal Bo' and Rossi (2011) for systematic evidence in Argentina.

ground with this work on focusing on the inner workings of autocratic systems, here the central interest is on individual incentives as opposed to power sharing across groups. A more detailed discussion of equilibriums with coups than what presented here is instead presented in Bidner, Francois, and Trebbi (2014).

Finally, this work speaks to the large political science literature on cabinet duration[5] and ministerial survival.[6] Relative to this literature, we depart in terms of focus, by targeting weakly institutionalized countries, and in methodology by addressing the specific duration dependence of the hazard functions, as opposed to investigating hazard shifters and covariates within partial likelihood approaches, as in the popular Cox model.

2 Leadership and Ministerial Survival in Africa

This section presents nonparametrically a set of stylized facts characterizing the process of selection and termination of national ministers in Africa. We will use this set of empirical regularities to guide the discussion in the following sections, but also to present our new evidence unburdened by any theoretical structure.

We recorded the names and positions of every government member that appears in the annual publications of *Africa South of the Sahara* or *The Europa World Year Book* between 1960 and 2004 and employ data on each national ministerial post since independence on Benin, Cameroon, Cote d'Ivoire, Democratic Republic of Congo, Gabon, Ghana, Guinea, Liberia, Nigeria, Republic of Congo, Sierra Leone, Tanzania, Togo, Kenya, and Uganda. These fifteen countries jointly comprise a population of 492 million, or 45 percent of the whole continent's population. For the biographical information for each minister, we search the *World Biographical Information System* (WBIS) database for explicit information on

[5] King et al (1990), Kam and Indridason (2005). Particularly, see Diermeier and Stevenson (1999) for a competing risk model of cabinet duration.

[6] The political science literature typically does not consider individual ministers as the relevant unit of observation, focusing instead on the entire cabinet. Alt (1975) and Berlinski et al. (2007) are exceptions centered on British cabinet members, while Huber and Gallardo (2008) focus on nineteen parliamentary democracies. To the best of our knowledge this is the first systematic study of this type focused on autocratic regimes.

his/her ethnicity, place and year of birth. The information is further complemented by detailed web searches and searches through LexisNexis. Finally, local experts were employed to cross-validate the data and fill missing observations when possible. The details on the ministerial data, as well as a thorough discussion of the evidence in support of the relevance of national governments in African politics, can be found in Rainer and Trebbi (2011) and in Francois, Rainer, and Trebbi (2015). Summary statistics of the sample by country can be found in Table 1. Table 2 reports spell-specific information for all ministers in the sample.

In Figure 1 we show our first empirical regularity. Leaders with more experience in government at the onset of their regimes tend to systematically hire ministers with more experience in government (both measures are proxied by the number of years recorded in previous cabinets). The figure reports both the linear fit and a nonparametric lowess fit, both underscoring a positive and significant statistical relationship between ministerial past political experience and leader's experience at regime onset. In Figure 2 we split senior and junior government posts. We define as senior posts the Presidency/Premiership deputies, Defense, Budget, Commerce, Finance, Treasury, Economy, Agriculture, Justice, Foreign Affairs. Leaders select more experienced ministers for more senior posts and they appear to do more so as their experience grows.

Table 3 shows how the positive correlation between ministerial past political experience and leader's experience at regime onset is robust to a number of possibly confounding dimensions. As in Figures 1 and 2, only cabinets at regime start are considered. To rule out the quasi-mechanical explanation of leaders and ministers simply belonging to the same age cohort and thus having a higher likelihood of interaction, we control for cohort distance between ministers and the leader, measured as the absolute value of the year of birth of the minister and the year of birth of the leader. To rule out co-ethnicity as a driver, we control for ethnolinguistic distance between minister and leader based on the number of Ethnologue linguistic branches following Fearon (2006). We also include country fixed effects and try various subsamples of our data, particularly cutting out the 1960-75 early postcolonial period. Clustering of the standard errors is performed at the Leader's identity level.

We now proceed to illustrating termination risks of both leaders and ministers. One important finding that will underlie all our subsequent analysis is that in both groups hazard rates exhibit distinctive time dependence patterns, but of completely different nature across the two.

Let us begin by considering the termination risk of leaders, as this issue has already received some investigation in past literature (see Bienen and Van De Walle, 1989). In Figure 3 we report nonparametric hazard estimates for the pooled sample of post independence African leaders, for ease of comparison with Bienen and Van De Walle's analysis, while in Figure 4 we report nonparametric hazard estimates for the fifteen countries in our sample. Although Figure 4 is naturally more noisy, both hazard functions clearly exhibit sharp negative time dependence. The termination risk starts around 17% during the first year in office for the leader, gradually reaching about half that likelihood of termination conditional on reaching 10 years in office. These figures are remarkably similar to those reported in Bienen and Van De Walle's analysis which ends in 1987, but now we extend the finding to the full post-Cold War period adding almost two decades worth of data.

Our novel results on the nonparametric hazard functions for the risk of termination of a minister under the same leader are reported in the four panels of Figure 5, which present the minister's empirical conditional probabilities of being terminated over time, i.e. their hazard functions. Let us also note that Figure 5 is conditional on the minister not being terminated because of the leader's own termination (this is a competing risk we will model explicitly below). Notice also that we perform the hazard analysis country by country, in order to reduce to a minimum the bias due to unobserved heterogeneity, which is particularly damning in duration models.[7]

The patterns are striking. For the vast majority of countries in our sample, ministers face

[7]Indeed, it is a known issue in duration analysis that pure statistical heterogeneity across hazard functions implies, when naively aggregated, a hazard function for the mixture distribution that is necessarily declining in analysis time; see Farber (1994) for a complete discussion.

increasing termination hazards over time under the same leader. In a subset of countries, after a specific number of years in government, hazard rates eventually drop, leading to a characteristic 'hump' shape. Typically, between the first and fifth year in office a minister sees his likelihood of dismissal increasing by about 50%.[8] To the best of our knowledge this fact is new and proves to be a remarkable departure from estimated termination risks not just of national leaders – as shown in Figures 3 and 4 – but relative to almost any other form of employment (Farber, 1994).

3 Model

We describe the problem of a leader who has to choose the personnel that will fill executive positions (ministries) in his inner circle. The key tension which the model is built to focus on is the leader's management of the trade-off between two dimensions. First, a static one, the leader wants to choose a minister with the optimal level of experience to manage each ministry at each point in time. Second, a dynamic consideration. The leader must monitor both the means and incentive for ministers to displace the leader and assume his position. It will be seen that a crucial part of the model hinges on how incentives and means change with length of experience in office. Calendar time $t = 0, 1, ...$ is infinite and discrete and leaders choose the cabinet at the start of every period. All individuals discount the future due to their own termination risk, the details of which we specify below.

3.1 The Static Problem: Ministry Output and Division

Each time a government insider, also referred to as a minister, is replaced in his post, the leader incurs a cost, denoted $\varepsilon > 0$, which we allow to be arbitrarily small. Let $k_i(t)$ be the political capital of minister i at time t. Political capital is accumulated through

[8] Note also the different levels of the baseline hazard rates for the different countries (see for example, Congo-Kinshasa), strongly supporting our approach of addressing country heterogenity in the most conservative way possible. Alternative corrections would require the use of parameterizations for the frailty in the data. We do not follow this approach here.

political experience, growing at constant rate g with time in office, and is useful in generating ministerial output. Specifically, if i is a minister in period t his output is $(k_i(t))^{\beta}$.[9] Assume that there is an elastic supply of ministers for each and every level of experience.

Denote the leader by l and assume that the leader installed at time t_l has capital level $k_l(t) = (1+g)^{t-t_l} k_l^0$, i.e. the leader's growth rate is also g while in office and k_l^0 is the leader's political capital at entry. A leader l appointing individual i as a minister has the potential to hold up production in $i's$ ministry. Intuitively, the minister in charge of a post requires an essential input, which the leader controls and can withhold at will.[10]

We assume that the hold up problem is solved by Nash Bargaining between the leader and minister over the ministry's output. Let the leader's bargaining power (in the Nash Bargaining sense) be denoted α, with $1-\alpha$ denoting the minister's. Suppressing time notation, this leads to the following division of ministerial surplus (where w denotes the amount of the ministry's value paid to the minister):

$$\max_{w} \left[\left(k_i^{\beta} - w \right)^{\alpha} w^{1-\alpha} \right]. \tag{1}$$

The threat points for each player are zero output in the ministry – either the minister contributes no effort, and/or the leader withholds the essential input.

The relative bargaining power, α, is assumed to be determined according to the relative political capital level of the leader l and his chosen minister, i, according to: $\alpha = \frac{k_l}{k_l+k_i}$.[11] This specification captures the important feature of the static problem that leaders can appropriate a larger share of ministry spoils the more powerful they are relative to their chosen minister. It introduces the important trade-off for leaders between having more

[9] We are also able to allow heterogeneity in ministries along the lines of ministerial importance. Specifically, it is easy to extend the model to allow for two types of ministries with differential production functions with varying β_m. With $m = J$ for junior ministries and $m = S$ for senior ones, with $\beta_S > \beta_J$. This is explored in the NBER working paper version, Francois, Rainer and Trebbi (2014).

[10] In Francois, Rainer and Trebbi (2014) we show it is also possible to allow that this hold up opportunity occurs only occasionally. For example, with probability H the leader can hold-up any single ministry, m in any period t, where H is i.i.d. across ministries and is drawn each period, separately for each ministry.

[11] Note that, for reasons of convenience, α is not denoted to depend on either i or l's political capital, for reasons that will become obvious below.

experienced ministers – who are good at production of output – but whose output produced is more difficult for the leader to expropriate for his own ends.

3.2 The Dynamic Problem: Means, Motive, and Opportunity for Coups.

Endogenous coups d'état come from government insiders seeking to become leaders. Realistically, coups are extremely costly to the leader, but in the current set-up we assume only that these costs are strictly negative for a leader. Even arbitrarily small costs of coups will suffice for our purposes.

Three factors determine whether a minister will decide to mount a coup: i) having the means to stage it; ii) having the incentives to stage it (i.e. the "motive" in undertaking a sanctionable action); and iii) having the actual opportunity of following through. In our model the leader will monitor means and motive, and, when necessary, preclude opportunity.

3.2.1 Means

In order to mount a coup, a government insider must establish sufficient connections within the government to coordinate the coup action. This plotting capacity is a function of the length of tenure an individual has had within the government and depends positively on the importance of the individual's position. Specifically, individuals grow their own coup capacity by the amount $c_i(t)$ each period t of their current stint in office, where $c_i(t)$ is an i.i.d. draw from a stationary distribution C with non-negative support.

A critical assumption is that coup capacity is regime-specific, unlike k, which persists across regimes. This assumption does not need to be this strict. Having coup capacity and political capital depreciate at different rates when the minister is outside the government would add considerable complexity but would suffice for our main results. However, faster depreciation of coup capacity than political capital is necessary in order to justify the empirical regularity of ministers reappearing in government after a first spell (about 0.34 of the ministers at regime onset share this characteristic).[12] It is also realistic. The capacity to run a ministry, while depending to some extent on connections with other arms of the government, depends much more heavily on the minister's own skill, experience and the personnel he appoints. A minister is able to choose most of the relevant players in a ministry himself upon assuming the position, and there is in fact considerable evidence that ministers do precisely this when they take over portfolios. Thus, ministerial output is extremely sensitive to the qualities that the minister himself brings to the post. The key one that we can observe, and on which we predicate output dependence in our model, is ministerial experience, hence our assumption that output depends on accumulated ministerial experience: $(k_i(t))^\beta$.

In contrast, coup capacity is more likely to depend on the overall composition and identities of individuals beyond any particular ministry in the administration at large. The capacity to undertake a coup depends on familiarity with key players in the administration; both in the military and in the set of government functionaries that will aid the plotters when they assume power. These key players are individuals who are not in the purview of the minister himself, as they are usually appointed by the leader, and change with the leader's departure. Hence our assumption that at calendar time t minister i who first entered into the government at time $t_i^0 < t$ has accumulated coup capacity $\sum_{\tau=t_i^0}^{t} c_i(\tau)$, where the aggregation is over the duration of the spell in the current government only. Coup capacity is common knowledge, and gives a minister the capacity to mount a coup if and only if it reaches a critical threshold, denoted $\overline{c}$; that is, if and only if $\sum_{\tau=t_i^0}^{t} c_i(\tau) \geq \overline{c}$.

Exogenous Threats

Leaders can be terminated for exogenous reasons other than coups. We assume a base leadership hazard $(1-\delta)$ that applies per period of leadership ad infinitum. This proxies for mortality/health threats of standard physiological nature. We similarly assume a base leadership hazard for ministers for reasons like ill health, retirement from politics, etc.: a

[12] Were ministers terminated because of an unfavourable trade off between coup capacity and political capital, it would be hard to rationalize leaders reappointing those very same individuals using a model like ours without the accompanying assumption that coup capacity depreciates faster.

$1 - \sigma$ probability event.

Additionally, the data shows a high potential for external threats to leaders early on in a regime (for an early contribution, see Bienen and Van De Walle, 1989). Upon inception, new regimes are extremely fragile, with a high probability of termination due to exogenous factors like foreign military interventions, sensitivity to shifts in international alliances, or simply lack of consolidation of the leaders' power base. Another way of interpreting such exogenous threats is to allow the model to capture both coups that are preventable by the leader (which he will never take a chance on, and which we model directly) from coups that are not preventable, possibly because originating from injudicious behavior of certain political actors, or from factors simply beyond the leader's control. Specifically, we model these external threats in a reduced-form way, positing that this exogenous fragility declines through time as a sequence of regime age specific continuation probabilities $\rho(t)$, that we will fit to the data when we come to estimate the model. We assume that a leader coming to power in period t_l has heightened fragility for t_δ periods implying that $\rho(\tau - t_l) < 1$ for $t_l < \tau < t_l + t_\delta$ and increasing with τ until $\rho(\tau - t_l) = 1$ for $\tau \geq t_l + t_\delta$. This implies that at time t_l the time path of discounting for a leader l follows $\delta\rho(1), ..., \delta^{t_\delta}\Pi_{s=1}^{t_\delta}\rho(s), \delta^{t_\delta+1}\Pi_{s=1}^{t_\delta}\rho(s), ...$ Such external threats are not only necessary for realism in the structural estimation, but affect also ministerial trade-offs in important ways. For instance, for a minister, staging a coup against an established and stable leader to possibly start anew on his own after a successful coup as the fragile new leader entails different incentives than staging a coup against a brand new and still fragile leader.

3.2.2 Timing

Timing is reported in Figure 6.

- Each existing minister comes in to period t with his personal coup capacity, $\sum_{\tau=t_i^0}^{t} c_i(\tau)$ for minister i, where period $t's$ draw was at the end of period $t-1$.

- The leader observes each minister's capacity and decides whether he will continue in his portfolio, or whether to replace him with a new minister who necessarily will have zero coup capacity.

- The minister and leader bargain over the division of ministerial surplus. Production occurs and consumption shares are allocated according to the Nash Bargain.

- Exogenous termination draws for both ministers and leader occur. Exogenous terminations for the leader imply dissolution of the cabinet, and a new leader, randomly drawn from the set of all individuals, to start next period (at which point he selects a new cabinet). Exogenous terminations for a minister leave a ministry vacancy to be filled at the start of the next period by the existing leader.

- Surviving ministers with sufficient coup capacity decide whether to mount a coup or not. If so, and successful, the coup leader will start as leader in the next period (multiple coups are allowed, and if more than one succeeds, a leader is drawn from the successors randomly). If the coup fails, or none is attempted, the leader stays in place. Failed coup plotters are removed and excluded from all future ministerial rents.

- At the end of the period, the increment to each minister's coup capacity is drawn from distribution C. Surviving ministers carry their coup capacity to the start of $t+1$ after which the sequence repeats.

3.2.3 Motive and Opportunity

The Value of Being Leader

Let $V^l(k_i(t), t)$, denote the net present monetary value that an individual of experience $k_i(t)$ has to becoming the leader at calendar time t. This monetary value is the aggregation of the leader's share of ministerial rents captured through hold up and the ensuing bilateral bargaining over ministerial spoils in each of the N ministries through time.[13] Since an

[13] We do not model the size of the cabinet endogenously. See Arriola (2009) for a discussion of how the cabinet size may be related to clientelistic motives.

unsuccessful coup leads to the protagonist's dismissal from government (and rents) forever, the net present value for a minister with capital $k_i(t)$ staging a coup at t that succeeds with probability $\gamma \in [0,1]$ equals $\gamma V^l(k_i(t), t)$.

The Value of being a Minister

Let $V^m(k_i(t), t_l)$ denote the net present value of being a minister, with capital $k_i(t)$ operating within a regime whose leader l took office at t_l. The value of being a minister depends on the flow value created by an individual's time in the ministry, the share of that flow value he appropriates, and the minister's estimates of his likelihood of continuing in office. Three different hazard risks affect this continuation probability each period. The first risk arises from something exogenous happening to the minister; the $1-\sigma$ exogenous shocks described above. A second risk arises from the conscious decisions of the leader to terminate a minister's appointment. If the leader decides i has become an insupportable risk, then minister i must go. This removes "opportunity" for the minister, which we assume can no longer stage a palace coup when ousted. The third threat to continuation for a minister arises from the leader being actually hit by his own exogenous shock, in case of which the whole cabinet is terminated.[14] In essence this means that the $(1-\rho(t))$ and $(1-\delta)$ risks also enter into the hazard function of a minister.

Ministerial coup incentives

It follows that a minister with capital $k_i(t)$, in a regime where the leader came to power in period t_l has no incentive to mount a coup against the leader in period t if and only if:

$$\gamma V^l(k_i(t), t) \leq V^m(k_i(t), t_l). \tag{2}$$

[14] We could, more correctly, allow for this discount to be less than $1-\delta$ for a minister, since some ministers remain in cabinet when leaders are exogenously removed. For now, assume full turnover.

3.3 Analysis

3.3.1 Optimal ministerial experience.

The Nash bargain in (1) yields $w^* = (1-\alpha)\, k_i^\beta$, so that the leader's share of output is αk_i^β. Given this, leader l chooses k_i at any time t to maximize the value he obtains from filling the ministry. Specifically, leader with k_l solves:

$$\max_{k_i} \left[\frac{k_l}{k_l + k_i} k_i^\beta \right],$$

where again we suppress time notation for simplicity. We denote the solution of the first order condition for a ministry by:

$$k_i\,(k_l) = \frac{\beta}{1-\beta} k_l. \tag{3}$$

The optimal solution for ministerial capital also determines α:

$$\alpha = \frac{k_l}{k_l + \frac{\beta}{1-\beta} k_l} = 1 - \beta.$$

Thus the bargaining power that ensues reflects the endogenous effect of the production primitive β on bargaining shares through the leader's optimal choice of ministerial experience. Note that the optimal solution as a ratio of leader's seniority is invariant to the leader's experience and therefore stationary in calendar time: $\frac{k_i(k_l(t))}{k_l(t)} = \frac{\beta}{1-\beta}$ for all t. We summarize:

Proposition 1. *1. Leaders pick identically experienced ministers for cabinet posts of the same seniority level.*[15]

2. Leaders with more experience pick cabinets with more experience.

3. The leader's experience and that of his optimal minister in any post grow proportionately.

The model thus presents no reason to turn over ministers in terms of productivity gains,

[15]Francois, Rainer and Trebbi (2014) shows that in the heterogeneous ministry extension of the model, leaders will select ministers with more experience for more senior posts.

since ministerial and leadership experience grow at the same rate. We now study what shapes ministerial incentives to stage palace coups and how the incentive compatibility constraint they face can render them a threat, and thus result in endogenous turnover.

3.3.2 Incentives to mount a coup

For a leader installed in period t_l the valuation of the leadership stream at any time $t \geq t_l$ is:

$$\begin{aligned} & V^l\left(k_l\left(t\right), t_l\right) \\ = \; & N\alpha \sum_{\tau=t}^{\infty} \delta^{\tau-t} \prod_{s=t+1}^{\tau+1} \rho\left(s-t_l\right)\left(k_i\left(k_l\left(\tau\right)\right)\right)^{\beta} \end{aligned}$$

where the notation $k_i\left(k_l\left(\tau\right)\right)$ denotes the leader choosing a minister of k_i given his own seniority $k_l\left(\tau\right)$. For simplicity, this value function is expressed assuming that discounting arises only due to exogenous risks (the terms δ and $\rho\left(t-t_l\right)$), with no risks due to "endogenous" coups along the equilibrium path. We shall indeed demonstrate subsequently, that such risks are almost costlessly avoided by the leader through shuffles, so we save on notation by excluding them from the outset. Using (3), the fact that $\alpha = 1-\beta$ and the constantly growing political capital, we can compute these infinite sums, yielding:

$$\begin{aligned} & V^l\left(k_l\left(t\right), t_l\right) \\ = \; & N\left(1-\beta\right) \sum_{\tau=t}^{\infty} \delta^{\tau-t} \prod_{s=t+1}^{\tau+1} \rho\left(s-t_l\right)\left(\frac{\beta}{1-\beta}\left(1+g\right)^{\tau-t} k_l\left(t\right)\right)^{\beta} \end{aligned}$$

Since from $\tau = t_l + t_\delta$ onwards we know that $\rho(t) = 1$, this implies that the valuation can be expressed in a finite form as follows:

$$
\begin{aligned}
(4) \qquad & V^l\left(k_l(t), t_l\right) \\
= \; & N(1-\beta)\left[\begin{array}{c}
\sum_{\tau=t}^{t_l+t_\delta-1} \delta^{\tau-t} \prod_{s=t+1}^{\tau+1} \rho\left(s-t_l\right)\left(\frac{\beta}{1-\beta}(1+g)^{\tau-t} k_l(t)\right)^\beta + \\
\delta^{t_l+t_\delta-t} \prod_{s=t+1}^{t_l+t_\delta+1} \rho\left(s-t_l\right)\left(\frac{\beta}{1-\beta} k_l\left(t_l+t_\delta\right)\right)^\beta \frac{1}{1-\delta(1+g)^\beta}
\end{array}\right].
\end{aligned}
$$

We have already established from (2) that the incentives for a minister to mount a coup at any time, t, depends on a comparison between the value to the minister of becoming leader, weighted by coup success probability, $\gamma V^l\left(k_l(t), t_l\right)$, and the value of remaining a minister $V^m\left(k_i(t), t_l\right)$ at that time. The dynamics of coup incentives (together with coup capacity) determine the shape of a minister's hazard function through time, since leaders will terminate ministers with both capacity and incentives to mount coups. The ministerial hazard through time is critically affected by the relationship between the shapes of these two value functions along a minister's tenure. However, since $V^m\left(k_i(t), t_l\right)$ depends on the endogenous decisions of the leader to dismiss the minister at all points in future, it is not possible to simply characterize the relationship between these two value functions.

We thus proceed as follows. Denote by $\widetilde{V}^m\left(k_i(t), t_l\right)$ the net present value of being a minister with capital $k_i(t)$ operating within a regime whose leader l took office at t_l, under the assumption that l will never 'endogenously' remove i from office. Intuitively, this value is (weakly) higher than the true net present value of being a minister at t, $V^m\left(k_i(t), t_l\right)$, as it removes from the true set of hazards the possibility of a leader deciding to remove i from office endogenously. It is easier to work with this simpler object ($\widetilde{V}^m\left(k_i(t), t_l\right)$), and as we will proceed to demonstrate, it will be sufficient to consider it alone when analyzing ministerial coup decisions. It can be expressed as:

$$
\begin{aligned}
(5)\qquad & \widetilde{V}^m\left(k_i(t), t_l\right) \\
= & \sum_{\tau=t}^{t_l+t_\delta} (\sigma\delta)^{\tau-t} \prod_{s=t+1}^{\tau+1} \rho\left(s-t_l\right) \beta \left((1+g)^{\tau-t} k_i(t)\right)^\beta \\
& + (\sigma\delta)^{(\max[t_l+t_\delta-t,0])} \prod_{s=t+1}^{t_l+t_\delta+1} \rho\left(s-t_l\right) \frac{\beta}{1-\sigma\delta(1+g)^\beta} \left((1+g)^{(\max[t_l+t_\delta-t,0])} k_i(t)\right)^\beta .
\end{aligned}
$$

Though simpler, it is still not possible to directly characterize the evolution of these value functions. The following result simplifies the problem considerably.

Lemma 1. *If $\widetilde{V}^m\left(k_i(t), t_l\right) < \gamma V^l\left(k_i(t), t\right)$ at t, then minister i will mount a coup against leader l in any period $\tau \leq t$ when he has the capacity to do so.*

All Proofs are in the Appendix.

The lemma implies that a minister with incentive to mount a coup at some future date will also have incentive to mount a coup today, provided he has the capacity to do so. This form of 'unraveling' is intuitive. Since coup capacity does not decay, the leader knows that a minister who would one day have incentive to move against the leader, will be able to do so when that day comes. But if he would do so at that point, the leader, knowing this, will dismiss him just before reaching that point. Anticipating this dismissal, the minister will act pro-actively and attempt a coup before that date. In turn, the leader, knowing this, will dismiss him first, and so on, up until the first date at which a coup capacity ensues.

3.3.3 Optimal Ministerial Turnover

Notice that the reasoning above does not depend on the relationship between the quasi value function $\widetilde{V}^m\left(k_i(\tau), t_l\right)$ and value function $\gamma V^l\left(k_i(\tau), \tau\right)$ at any points $\tau < t$, so the difficult problem of characterizing the evolution of these functions through a minister's tenure can be avoided. Instead, it will be sufficient to study the relationship between the quasi value function and the value of being a leader. Accordingly, the following definition will be useful.

Definition: Let $\Upsilon(k_i(t))$ denote all elements of $\tau \geq t$ such that $\widetilde{V}^m(k_i(\tau-1), t_l) < (\geq)$ $\gamma V^l(k_i(\tau-1), \tau-1)$ and $\widetilde{V}^m(k_i(\tau), t_l) \geq (<) \gamma V^l(k_i(\tau), \tau)$.

Intuitively, $\Upsilon(k_i(t))$ denotes the set of dates from t onwards when the quasi value function for a loyal minister with experience k_i (i.e., $\widetilde{V}^m(k_i(t), t_l)$) crosses the value function of a minister with k_i challenging the leader (i.e., $\gamma V^l(k_i(t), t)$).

We will now characterize optimal ministerial turnover in terms of a single "safe" date for minister i with respect to leader l which we denote $\bar{T}_i = \bar{T}(k_i(t), t_l)$. $\bar{T}_i$ denotes the date at and after which minister i will NOT mount a coup against leader l, but before which minister i will mount a coup, if he has capacity to do so. We now show the existence of such a safe date, and how it can be determined by comparing these value functions at a single point.

Lemma 2. *If $\Upsilon(k_i(t)) = \emptyset$, then: If and only if $\widetilde{V}^m(k_i(t_0), t_l) \geq \gamma V^l(k_i(t_0), t_0)$: $\bar{T}_i = t_0$. Otherwise $\bar{T}_i$ does not exist. If $\Upsilon(k_i(t)) \neq \emptyset$, then: If and only if at $\tau \equiv \sup \Upsilon(k_i(t))$: $\widetilde{V}^m(k_i(\tau), t_l) \geq \gamma V^l(k_i(\tau), \tau)$ then $\bar{T}_i = \sup \Upsilon(k_i(t))$. Otherwise $\bar{T}_i$ does not exist.*

The Lemma provides a simple means by which to calculate a minister's safe date. It requires considering the crossing of the quasi value function of a loyal minister $\widetilde{V}^m(k_i(t), t_l)$ with that of a coup challenge $\gamma V^l(k_i(t), t)$ only at the last date where these intersect.[16] If beyond that date a minister with capacity wants to undertake coups, then by Lemma 1, the minister will undertake coups whenever he has the capacity, and a safe date does not exist. If beyond that date the minister does not want to undertake coups, then he will not do so once the date is reached, but will strictly wish to do so before hand, again due to Lemma 1, thus defining the safe date. If the two value functions never intersect, then the minister is either always safe or never safe, depending on which value function is greater according to condition (2). Since the lemma provides a simple means to computationally determine

[16]Note that the definition of Υ excludes a situation where the highest intersection point is where the value functions are equal for more than one period. This is a point of measure zero in the model's parameter space. Including this possibility changes no results. It does require introducing more cumbersome notation so we proceed by ignoring it. Details are available from the authors upon request.

safe dates for varying parameter configurations, it will be key in allowing us to structurally estimate the parameters of the model.

Leaders incur costs $\varepsilon \to 0$ when replacing a minister. Therefore if a minister does not present a coup threat to the leader, and presuming that he was chosen optimally in the previous period, the leader strictly prefers to keep him in the next period. We have already seen that in order to determine whether the minister is a coup threat, at any time t the leader monitors both the minister i's means and incentives via the safe date. This allows for a simple characterization of ministerial turnover. The following describes how the leader determines ministerial turnover.

Proposition 2. *Consider minister i at time t under a leader of vintage t_l. If*

$$\sum_{\tau=t_i^0}^{t} c_i(\tau) \geq \bar{c}. \tag{6}$$

does NOT hold, then minister i is reappointed for another period.
If (6) holds, then leader l dismisses i if and only if $t < \bar{T}_i = \bar{T}(k_i(t), t_l)$.

The proposition outlines the two-step decision process a leader makes for each minister's renewal. Each period the leader computes coup capacity (6) and the safe date $\bar{T}_i = \bar{T}(k_i(t), t_l)$ for all N ministers. He replaces a minister if and only if (6) holds and they are not at their safe date. Otherwise, the minister continues another period.

Though we have specified safe dates as a function of ministerial capital, $k_i(t)$ and the leader's vintage, we can now see by using Proposition 1 how such dates are, in effect, fully pinned down by the leader's own capital, and hence why it is more direct to attribute safe dates to leaders. Since the leader chooses his optimal ministerial composition in each period to solve the static problem of value maximization, he picks a unique optimal $k_i(t)$ for each ministry that is based on his own level of $k_l(t)$. Consequently, once the optimal level of a minister's capital (as computed by the static allocation problem of a leader delineated in equation (3)) is such that it exceeds the safe date, (as the time where the minister's net present value from a coup is dominated by the net present value of loyalty) then all ministers in the leader's cabinet are free from endogenous terminations. In the next section we show that this can generate the observed non-monotonicity in ministerial hazard functions, moreover we specify further reduced form implications for this theoretical model, and specify how we can use the data to identify the model's key parameters.

4 Hazard Functions, Likelihood, and Identification

The model allows us to now specify the equilibrium survival and hazard functions. Given our interest in the shape of the time dependence of the endogenous termination risk for ministers, rather than on the role of specific covariates per se, our approach is different to commonly employed proportional hazard models, such as the Cox model. In addition, our survival model tackles head on the heterogeneity across leaders and ministers of different vintages under the same leader in a way that is extremely general, as will become clear below.

In terms of notation we have so far focused on calendar time t. We now introduce notation for analysis time (i.e. time since minister i takes office at t_i^0) and use the symbol $'$ to distinguish analysis time from calendar time, or $t_i' = t-(t_i^0 - 1)$. Stripping away unnecessary indexes, we start by defining the unconditional probability of an insider's termination t' periods after his appointment, $f(t')$. Notice that $f : \mathbb{N}^+ \to [0,1]$ is a discrete density function defined over years in office (the sample frequency available to us) and indicate with $F(t')$ its corresponding cumulative function, thus defining the minister's survival function $S(t') = 1 - F(t')$.

The model postulates the presence of three competing and statistically independent termination risks for a minister: i) the minister's endogenous dismissal likelihood $\Pr\left(\sum_{\tau=1}^{t'} c\left(\tau\right) > \bar{c}\right)$ before $\bar{T}' = \max\left[\bar{T} - \left(t^0 - 1\right), 1\right]$ periods ; ii) the minister's idiosyncratic dismissal likelihood $1-\sigma$; and iii) termination due to the leader's demise (due to $1-\delta$ or $1-\rho\left(t - t_l\right)$). The data enable us to distinguish whether the minister is terminated under the same leader (and hence must have been victim of an endogenous termination or of a $1-\sigma$ shock), indexed by $r=1$, or whether the minister is terminated because the leader changed (and hence due to either a shock $1-\delta$ or $1-\rho(t-t_l)$) indexed by $r=2$[17]. In a competing risk model it is useful to distinguish the overall hazard for a minister, $\lambda(t', t_l) = f(t', t_l)/S(t', t_l)$, from the risk-specific hazards $\lambda_r(t', t_l)$ for risks $r = 1, 2$.

It follows that the survival function, i.e., the probability of minister i surviving to t'_i under a leader installed at t_l is:

$$(7)\ \ S(t'_i, t_l) = \begin{cases} \sigma^{t'_i-1}\delta^{t'_i-1}\Pi_{s=1}^{t'_i-1}\rho\left(t_i^0+s-t_l\right)\Pr\left(\sum_{\tau=1}^{t'_i-1}c(\tau)\leq\bar{c}\right) & if\ t'_i<\bar{T}'_i \\ \sigma^{t'_i-1}\delta^{t'_i-1}\Pi_{s=1}^{t'_i-1}\rho\left(t_i^0+s-t_l\right)\Pr\left(\sum_{\tau=1}^{\bar{T}'_i-1}c(\tau)\leq\bar{c}\right) & if\ t'_i\geq\bar{T}'_i, \end{cases}$$

where $\bar{T}'_i = \max\left[\bar{T}_i - \left(t_i^0 - 1\right), 1\right]$. The probability of a minister to be terminated at t'_i periods is:

$$f(t'_i, t_l) = S\left(t'_i - 1, t_l\right) \times$$
$$\begin{cases} \left[1-\sigma\delta\rho\left(t_i^0+t'_i-t_l\right)\Pr\left(\sum_{\tau=1}^{t'_i}c(\tau)\leq\bar{c}\,\middle|\,\sum_{\tau=1}^{t'_i-1}c(\tau)\leq\bar{c}\right)\right] & if\ t'_i<\bar{T}'_i \\ \left[1-\sigma\delta\rho\left(t_i^0+t'_i-t_l\right)\right] & if\ t'_i\geq\bar{T}'_i. \end{cases}$$

The hazard function $\lambda(t'_i, t_l)$ indicating the probability of a minister being terminated during

[17]For simplicity we exclude co-occurrence of health shock of the minister and leader's exogenous termination (health shocks or otherwise). We are not able to separate endogenous terminations of ministers on the part of leaders from sudden death or incapacitation $(1-\sigma)$, because of lack of data on natural incapacitations for our ministers. We could separate terminations of ministers due to sudden death or incapacitation of the leader $(1-\delta)$ from those due to exogenous threats to the leadership $(1-\rho(t-t_l))$ because data on natural incapacitations/deaths for all leaders are available, but we chose not to. The literature has already established good benchmarks for δ and we can simplify the estimation by calibrating this (not particularly interesting) parameter.

period t_i' conditional on having survived up to analysis time $t_i' - 1$ is

$$\lambda(t_i', t_l) = \begin{cases} 1 - \sigma\delta\rho\left(t_i^0 + t_i' - t_l\right) \Pr\left(\sum_{\tau=1}^{t_i'} c\left(\tau\right) \leq \bar{c} \middle| \sum_{\tau=1}^{t_i'-1} c\left(\tau\right) \leq \bar{c}\right) & if\ t_i' < \bar{T}_i' \\ 1 - \sigma\delta\rho\left(t_i^0 + t_i' - t_l\right) & if\ t_i' \geq \bar{T}_i'. \end{cases}$$

Now, the hazard function can be easily broken up in to cause-specific hazard functions. The hazard function $\lambda_1\left(t_i', t_l\right)$, indicates the probability that an insider is terminated endogenously by the leader or becomes incapacitated during period t_i', conditional on having survived up to analysis time t_i'. It is

$$\lambda_1(t_i', t_l) = \begin{cases} 1 - \sigma \Pr\left(\sum_{\tau=1}^{t_i'} c\left(\tau\right) \leq \bar{c} \middle| \sum_{\tau=1}^{t_i'-1} c\left(\tau\right) \leq \bar{c}\right) & if\ t_i' < \bar{T}_i' \\ 1 - \sigma & if\ t_i' \geq \bar{T}_i'. \end{cases} \tag{8}$$

The hazard function $\lambda_2\left(t_i', t_l\right)$, indicates the probability of an insider being terminated due to a leader change during period t_i', conditional on having survived up to analysis time t_i', is

$$\lambda_2(t_i', t_l) = 1 - \delta\rho\left(t_i^0 + t_i' - t_l\right) = 1 - \delta\rho\left(t - \left(t_l - 1\right)\right). \tag{9}$$

Having established the form of the hazard function, the following proposition establishes the general features that it exhibits:

Proposition 3. *The hazard function $\lambda_1(t_i', t_l)$ satisfies the following properties:*

1. $\lambda_1(t_i' + 1, t_l) > \lambda_1(t_i', t_l)$ *for analysis time* $t_i' < \bar{T}_i' - 1$ *and* $\lambda_1(\bar{T}_i', t_l) < \lambda_1(\bar{T}_i' - 1, t_l)$*;*

2. $\lambda_1(t_i' + 1, t_l) = \lambda_1(t_i', t_l)$ *for* $t_i' \geq \bar{T}_i'$ *;*

3. $\lambda_1(t_i', t_l, J) \leq \lambda_1(t_i', t_l, S)$ *for* $t_i' < \min\left[\bar{T}_i'\left(S, k_i\left(t\right), t_l\right), \bar{T}_i'\left(J, k_i\left(t\right), t_l\right)\right]$.

   Recall that λ_2 satisfies the following properties:

4. *For any minister* $\Delta\lambda_2(t, t_l) < 0$ *for calendar time* $t < t_l + t_\delta$*;*

5. *For any minister* $\Delta\lambda_2(t, t_l) = 0$ *for calendar time* $t \geq t_l + t_\delta$.

The results here thus demonstrate the intimate connection between leader instability and minister hazard rates that are the hallmark of our model. Intuitively the reason ministers face high and increasing threats under new leaders is because their leaders are so fragile. Being loyal to a leader likely to be displaced by forces that are not within his control has low expected future value. New leaders, knowing this, rotate their cabinets frequently in response to their cabinet members accumulating coup capacity, as they will act on it. But when a leader is sufficiently experienced, and hence sufficiently entrenched, the return to ministerial loyalty is relatively high and leaders need not fear the formation of cabinet specific links and connections on the part of ministers as much. Consequently, more experienced leaders need not rotate their cabinets as often.

The first feature of λ_1 is that for $t' < \bar{T}'$ the hazard is strictly increasing, as the probability of remaining below the minimal coup capacity decreases over time. This is a common feature of cumulative shock models to which this setup is theoretically close. The second feature is that once an insider passes the threshold time $\bar{T}'$, the hazard function drops discontinuously, as the minister's endogenous dismissal likelihood goes to zero, and the hazard rate for $r = 1$ becomes constant at $1-\sigma$.[18] In addition, the critical $\bar{T}' < +\infty$ at which the hazard rate drops comes later for leaders with less experience at given calendar time t. The hazard function λ_2 is monotonically decreasing in analysis time before calendar time $t_l + t_\delta$ is reached, at which point it becomes constant at $1 - \delta$.

Parametric Specifications

A set of parametric restrictions are required before specifying the likelihood function. First, a process for the leader's fragility to external threats $\rho\,(t - t_l)$ is necessary. We allow

[18] In the extension of the model with heterogeneous ministries we show that if i is in a senior ministry the drop will come sooner, but the hazards will drop from a higher level, specifically by a shift factor $M_S > 1$ if $m = S$ until the time of the drop. In comparative terms, the hazard function will be higher at the start for senior ministers, then lower after the senior ministers become safe but the juniors have still not reached safety, and then both will eventually plateau to $1 - \sigma$ beyond each critical point. See Francois, Rainer and Trebbi (2014) for further details.

a nonlinear increase over calendar time $[t_l, t_l + t_\delta]$ as $\rho(t - t_l) = \left(\frac{t - t_l}{t_\delta}\right)^\zeta$ with $\zeta > 0$. We also calibrate $g = 0.05$ and $\delta = 0.95$. The baseline exogenous ministerial shock is set at $\sigma = 0.90$.[19] Note that δ and σ are calibrated to match the termination hazards in the raw data as leader and minister tenures tend to infinity[20].

Next we will assume C to be $Exponential\,(\varsigma_c)$ with scale ς_c; a convenient form as it has positive support, only one parameter, and its $n-$fold convolution is closed-form.[21] Since $c(t)$ are independent draws from an exponential with scale ς_c, then $\sum_{\tau=1}^{t} c(\tau) \sim Gamma\,(t, \varsigma_c)$, where t is the Gamma's shape and ς_c its scale. Since ς_c is not separately identifiable from $\bar{c}$, we will normalize $\bar{c} = 1$.

For minister i under leader of vintage t_l observed to leave the cabinet after t_i' periods due to risk r, define the dummy $d_i = 1$ if i is not right censored[22] and 0 otherwise, and the dummy $r_i = 1$ if i is terminated by risk 1 and 0 otherwise. Define the set of structural parameters of the desire and capacity functions $\Gamma = (\beta, t_\delta, \zeta, \gamma, \boldsymbol{\varsigma}_c)$. While parameters (β, t_δ, ζ) are going to be assumed constant across countries and leaders, we are going to allow the parameter ς_c to differ across countries (allowing the accumulation of coup capacity to vary at the national level and indicating it in bold as a vector) and the parameter γ to vary at the country-leader level (allowing the coup success likelihood to vary from regime to regime).

Likelihood Function

Define for a minister i given experience at entry of his leader k_l^0 and vintage t_l the vector

[19] With the exception of Congo where it is set to $\sigma = 0.65$ due to the extremely high baseline hazard specific to this country. This is probably due to specific features of the Mobutu's government that the model is only partially able to capture.

[20] These quantities can be read as 1 minus the rightmost hazard values in Figure 3 and the rightmost hazards in the "After" panel of Figure 8, which will be described carefully below.

[21] In the extension of the model with ministry heterogeneity, explored in Francois, Rainer and Trebbi (2014), we further assume that $m(t) = 1$ if $m = J$ at time t and $m(t) = M_S > 1$ if $m = S$, implying that the plotting capacity of a minister grows proportionately more with time spent in senior posts (central and important positions, like Defense or Treasury) as opposed to junior ones (peripheral ones, like Sports).

[22] Left censoring is not possible within our sample, as all countries are considered from the start of their postcolonial history.

$\mathbf{x}_i = [k_l^0, t_l, r_i, d_i]$. The likelihood contribution of observing exit at t_i' is then:

$$\begin{aligned} g\left(t_i', \mathbf{x}_i; \Gamma\right) &= f(t_i', \mathbf{x}_i; \Gamma)^{d_i} \times S(t_i', \mathbf{x}_i; \Gamma)^{1-d_i} \\ &= \left[\lambda_1(t_i', \mathbf{x}_i; \Gamma)^{r_i} \times \lambda_2(t_i', t_l)^{1-r_i} \times S(t_i' - 1, \mathbf{x}_i; \Gamma)\right]^{d_i} \\ &\quad \times S(t_i', \mathbf{x}_i; \Gamma)^{1-d_i} \end{aligned}$$

where $f(.)$ is defined above, $S(.)$ is given from equation (7) and λ_1, λ_2 are given in equations (8) and (9) respectively. The log-likelihood for a sample $i = 1, ..., I$ of ministerial spells[23] is then:

$$\mathcal{L}\left(\Gamma\right) = \sum_{i=1}^{I} \ln g\left(t_i', \mathbf{x}_i; \Gamma\right). \tag{10}$$

Identification and Reduced Form Implications

The apparently simple formulation (10) is deceptive. First, much of the identification here relies on the unobserved safe dates $\bar{T}_i'$ which impose stark discontinuities on the hazard functions. Second, hazard functions are heterogenous across ministers of different vintages even under the same leadership. To see this, consider a leader with a safe date twelve years from the time he was installed. Minister A installed at the same time as the leader faces a different hazard function than minister B installed five periods into the leader's tenure (hence belonging to a different "vintage"). At year 1 of his tenure A faces twelve periods of endogenous risk ahead. At year 1 of his tenure B (already five periods closer to the safe date) faces only seven periods of endogenous termination risk. Interestingly, the pooling of ministers at different distance from the leader-specific safe date $\bar{T}$, with each ministerial vintage characterized a discontinuous hazard function as in Proposition 3, is precisely what allows the model to fit the smooth hump-shaped hazard functions in Figure 5. This is

[23]With a slight abuse of notation we indicate with i both the minister and ministerial spells. Typically ministers present only one spell, but certainly not always. The implication in the loglikelihood (10) is that we consider here separate spells of the same minister as different observations. However, we do maintain memory of the experience of the minister through the initial political capital stock k_i^0, which also influences the coup incentives and is higher at every subsequent spell of the same individual.

because, when in the estimation we move about the safe date, the underlying mixture of individuals deemed safe versus still exposed to termination at each t' changes. The humps visible in Figure 5 are therefore driven by the mix of ministers terminated and those surviving before and after the safe date[24].

To see this point more clearly, consider Figure 7. In a simulation of $10,000$ ministerial spells under the same leader with safe date set at 7 years in office, it is possible to trace out nonparametrically all the vintage-specific hazards (i.e. the hazard functions of ministers hired at different points in the leader's tenure and hence at different distances from his safe date). In Figure 7 we can detect the role of the safe date in causing the drop in the hazards at different tenures by considering ministers appointed when the leader himself starts, ministers appointed 3 periods in the leader's tenure, 4 periods in, and even ministers appointed after the safe date, etc. The figure reports the hump-shaped estimated hazard obtained when such heterogenous hazard functions are all pooled together, as we in fact performed in Figure 5. This is essentially how our empirical model fits the hump-shaped hazards (and possibly increasing or flat hazards, depending on the existence of $\bar{T}$).

Due to scarcity of observations, we cannot perform the same exercise in Figure 7 with actual data. However, it is possible to show in the raw data how well the intuition provided by our model for a break of the hazard structure at the safe date $\bar{T}_i'$ holds. For simplicity in Figure 8 let us set across all countries in our sample a given safe date $\bar{T}' = 12$.[25] Figure 8 requires estimation of termination hazard rates before and after twelve years in government by the same leader, so in order to get sufficient data we bundle all countries at the cost of introducing heterogeneity.[26] The two panels in the figure show how the nonparametric hazards change around the safe date threshold in line with Proposition 3. In the "Before"

[24]Notice also that by construction the peak of the hazards in Figure 5 has to come necessarily before $\bar{T}_i$ as the concavity comes from the aggregation of discontinuous hazard functions with different peaks depending on the ministerial vintages (i.e. how long before or after the safe date each minister was hired).

[25]This is representative of what implied by our model in the estimates below for hump shaped hazards peaking around $4-5$ periods of ministerial careers as in Figure 5.

[26]The only precaution against heterogeity we follow here is to remove the Congo-Kinshasa, a large outlier in baseline hazard levels as already observed.

panel of Figure 8 we consider any minister who starts before the leader reaches $\bar{T}'$ years of tenure and we censor all spells at the year when the leader reaches his safe date. In the "After" panel of Figure 8 we consider any minister who is terminated after the safe date or starts and finishes after the safe date.[27]

The hazards of termination appear clearly increasing before the safe date in line with point 1 of Proposition 3, while they tend to fall after the safe date $\bar{T}$ decreasing to the theoretical level $1 - \sigma$. Both estimated slopes for the linear fit in Figure 8 are statistically significant at the 1% confidence level. Notice that, other than splitting the ministerial duration data before and after twelve years into the leader's tenure, we do not impose any other restriction on the data to produce these patterns in the hazards. In addition, these patterns do not depend on our choice of $\bar{T}$ and appear for safe dates placed between 8 to 14 years in office for the leader. Table 4 lists the linear coefficients corresponding to the slopes reported in Figure 8 for this range of common safe dates and their statistical precision (coefficients are typically significant at 1% and always of the correct sign). As can be seen in Table 4, ministers face increasing hazards early in the leader's tenure, but termination hazards tend to fall pass a safe date for the leader. The pattern in Table 4 is a very peculiar empirical regularity implied by our model, a regularity that competing mechanisms of ministerial selection would have difficulty matching in an intuitive fashion.

Along the same lines as Table 4, an additional reduced-form implication of the model is that, within a given cabinet in a given year before the safe date, the likelihood of exit for a minister should be increasing in ministerial tenure. Table 5 reports the contrasts in the likelihood of exit by tenure levels of ministers controlling for cabinet-year fixed effects (equivalent to country-year in our setting), considering safe dates placed between 8 to 14 years in office for the leader[28]. Each coefficient in the table reads as the additional likelihood $\mu_{t'}$ of endogenous exit of minister i of tenure t' under leader l at year t relative to a minister

[27] Notice that here we do not need to be concerned with left censoring, as the hazards are in theory constant after the safe date according to our model.

[28] By changing the safe date here we simply determine where we truncate the sample of analysis.

starting exactly at t, so that our model predicts the entries to be positive and increasing with ministerial tenure. More explicitly, we estimate in our panel of ministers the simple linear probability model:

$$exit_{ilt} = \sum_{t'=1}^{\bar{T}'} \mu_{t'} I(i \text{ has tenure } t') + \psi X_{il} + \varkappa_{lt} + \nu_{ilt},$$

where $exit_{ilt}$ is a dichotomous exit indicator, $I()$ is the indicator function, $\varkappa_{lt}$ are country-year fixed effects, and X_{il} are controls for top positions, ethnic distance from leader, and year of birth distance from leader. By and large, in Table 5 we detect clearly the type of risk accumulation our model predicts: positive and generally increasing $\mu' s$. For instance, in the first column, taking as reference an average exit likelihood of 21% in the first year in office, two years in office add 3.6% extra likelihood of termination, while six years add 8.7%. There is little variation due to the placement of the common safe date.

For identification, we can take advantage of the useful separability of our problem. We do not observe the amount of political capital of each minister $k_i(t)$, but we have handy observational proxies of political capital for ministers and leaders. Define the observed cumulated experience in government (i.e. number of years served in any cabinet capacity) at calendar time t by minister i, $\tilde{k}_i(t)$ and likewise for the leader l, $\tilde{k}_l(t)$. We can realistically posit that years of experience are a noisy, but unbiased, proxy of political capital:

$$\begin{aligned} k_l(t) &= \tilde{k}_l(t) + \varepsilon_{lt} \\ k_i^m(k_l(t)) &= \tilde{k}_i(t) + \varepsilon_{it} \end{aligned}$$

where ε is a mean zero error uncorrelated across individuals. Recall that at any date t the model implies $k_i(k_l(t))/k_l(t) = \beta/(1-\beta)$ as a steady relationship between ministerial and leader's political capital.[29] By rearranging and pooling across all leaders/countries in our

[29] Although apparently restrictive, the result of constant capital across ministries is a necessary condition for dealing parsimoniously with the lack of clear proxies of political capital of government insiders. Such a metric is even arduous to define in democratic regimes, where political data is much more transparent

sample l and all i at t_l it is therefore possible to estimate:

$$\tilde{k}_i(t_l) = \frac{\beta}{1-\beta}\tilde{k}_l(t_l) + \varphi_{lt_l} + \varepsilon^*_{it_l} \tag{11}$$

where $\varphi_{lt_l} = \frac{\beta}{1-\beta}\varepsilon_{lt_l}$ is a leader-specific fixed effect. The auxiliary regression (11) is particularly useful as it directly delivers estimates for $\hat{\beta}$ independently of the other parameters of the model.

Further, the parameters (t_δ, ζ) governing the hazard λ_2 can also be directly recovered by fitting a parametric hazard model to the leaders' termination data alone (the same data used in Figure 1 and 2).

Given the common parameters (β, t_δ, ζ), the vectors of coup success and coup capacity parameters (γ, ς_c) governing the hazard λ_1 are estimated postulating a safe date for each leader and iterating until a global maximum of the likelihood function is obtained. [30]

5 Estimation

Table 6a reports the maximum likelihood estimates for all countries. One first important parameter that is estimated through the ministerial data is the technological parameter β, which also identifies the bargaining power of the leader relative to his cabinet insiders. We impose a common β for all countries. Diminishing returns to ministerial political capital appear to kick in very early in the data, as the estimated $\beta = 0.055$ imposes a substantial

and readily available than in Africa, but it is even more so in our context. Clearly the observed cumulated experience in government of any politician is only one partial dimension of his/her political capital. Focusing only on previous years in government as a measure of political experience of a minister could thus underestimate the effective level of political capital. For instance, experience as a party cadre or within particular pre-colonial ethnic institutions (i.e. the role of paramount chiefs in Sierra Leone) are hard to measure, but surely a factor in determining the amount of political capital of leaders and ministers. Our approach is to leverage the multiple observations of career ministers over time in order to pin down the patterns of average political experience within the dictator's inner circle. This obviously sacrifices some heterogeneity across ministers along the $k_i(t)$ dimension, but it is the consequence of paucity of accurate proxies for $k_i(t)$. Part of this heterogeneity is however recovered in estimation by allowing for country-specific parameters.

[30] Given the parsimony of our model, the likelihood function depends on a relatively small number of parameters. This allows for a fairly extensive search for global optima over the parametric space. In particular, we employ a genetic algorithm optimizer.

degree of curvature in the production function. This implies relative insensitivity of the political production process to the experience of the minister ensuring that the bargaining power of the minister appears low. The bargaining power of the leader can be computed as $\alpha = 0.945$ relative to ministers.

The country-specific coup capacity parameter ς_c and leader-specific coup success probability γ are essential in determining whether a country exhibits a safe date or not. The absence of a safe date implies the hazard of ministers will be monotonically increasing, as per Proposition 3. If a leader exhibits a safe date, the hazard is non monotonic.

The estimates for ς_c are indicative of the speed at which the coup capacity threshold (6) is met by a government insider. This parameter governs the steepness of the hazard function. Specifically, ς_c identifies the scale of the exponential shocks to the capacity of staging coups, or the speed at which ministers might be building a "power base" (Soest, 2007). The higher ς_c the faster coup capacity accumulates and the faster the leader is bound to fire his ministers. The range of ς_c is varied. For example, the "musical chairs" of Mobutu Sese's Congo generate a high estimate of 0.61, implying extremely high churning. The more stable Cameroon has a value of 0.36. To see heuristically why a scale of 0.61 would imply a high value of churning one has to compute the expected time at which a threshold of 1 is reached [31] by the convolution of the coup capacity c shocks. Since the scale of an exponential located at 0 is its expected value, then in Congo there's an accumulation of 0.61 per period, or equivalently the threshold for coup capacity may be reached in less than 2 years on average. Instead, for $\varsigma_c = 0.36$ the threshold is reached in about 3 years, and so on. Obviously these figures imply sharply decreasing survival functions, as discussed below.

The vector γ is the most complex part of the parameter space to pin down due to the sharp discontinuity presented by Proposition 2.[32] We are however able to identify the parameters in Montecarlo simulations. Given the discreteness of the safe date (measured in years), there

[31] 1 is in fact our normalized value for the coup capacity threat level $\bar{c}$.

[32] The parameter γ enters into the condition through its effect on the safe date. It shifts the value of challenging for the leadership $\gamma V^l(k_i(t), t)$ relative to the value of loyalty $\widetilde{V}^m(k_i(t), t_l)$, which as shown in Lemma 2 pins down the safe date.

is an interval of coup success probabilities satisfying the condition in Proposition 2 and each γ can only be set identified. In part b of Table 6 we report the lower and upper bound on interval of the γ parameters for each leader, ordered over time and by country. In case ministers under a leader are never safe (i.e. they always have an incentive to stage coups), the interval includes the extreme 1 (i.e. coups succeeding surely cannot be ruled out). As an example for how to read Table 6b, Ahmadou Ahidjo corresponds to the first leader of Cameroon and has a γ in a tight neighborhood of 0.10 percent, while Paul Biya, Cameroon's second leader , has a γ in a tight neighborhood of 0.13 percent, and so on.

The parameter γ ranges from 0.1 to 0.25 percent typically. This does not obviously imply implausibly unlikely coup successes. What is reassuring is that the estimates appear larger in countries with more troubled histories of coups and plotting like Congo and Nigeria, than in countries with relatively more stable autocratic governments, like Gabon and Cameroon.

Table 6a also reports the leader's hazard parameters. We impose a common vector (t_δ, ζ) for all countries, given the typical paucity of leaders per country which would make an estimation by country impossible. Leaders reach a point of constant low hazard δ after $t_\delta = 15$ years in office and along the way we observe a smooth drop in regime fragility ($\zeta = 0.0567$). Both are very tightly estimated parameters.

Concerning the fit, the model is able to capture the non-monotonic nature of the termination hazard functions in countries with safe dates, while accommodating monotonically increasing hazard functions in the remaining countries which do not exhibit safe dates. In Appendix Figure A1 we report the model fit for all countries as well as the nonparametric hazard fit. The model also offers remarkably good fit of the survival functions of the ministers, also reported for each country separately in Appendix Figure A2. Survival functions are obviously very important to the estimation of the overall duration of each minister, as evident from our likelihood function, so it is reassuring the fit is tight along this dimension as well.

An important check we perform on our model is to restrict estimation exclusively to ministers in top cabinet positions[33]. In Appendix Tables A1a and A1b we report the maximum likelihood estimates restricting the sample to the senior ministerial posts only. Given that senior ministers are the most plausible source of replacement risk for the leader, one may want to make sure that the estimated parameters do not vary wildly relative to the baseline and the fit remains reasonable. In fact, were the estimates extremely unstable relative to the baseline, this might be a source of concern, given the focus on a subset of the data where coup concerns should be more salient. Tables A1(a,b) are reassuring in this sense, as the implications of Table 6(a,b) are largely confirmed, with one model's points estimates typically within confidence bands of the other specification.

6 Alternative Duration Models

This section discusses a set of relevant alternatives relative to our main model. The goal is to provide support for our modeling choices by rejecting competing theoretical mechanisms that do not match the data.

Consider first what is, likely, the most intuitive of all alternatives: leaders are tantamount to employers hiring workers and try to select the best ministers, laying off the rest. This is a pure *selection* mechanism of ministerial personnel based on learning workers' type/match quality on the part of the leader. Without providing an explicit microfoundation, which would be redundant, the idea of a selection motive affecting termination risks for ministers works through the screening of the minister's types. Early on in their tenure low quality ministers are to be screened out and only talented ministers stay.

It is well known that selection delivers a downward-sloping hazard function over time in office under the same leader. This is amply discussed in the vast (and related) labor economics literature concerned with job separations in duration models of employment (so called 'inspection good models' with no gradual learning about the employer-employee match, Jovanovich, 1984). Where we can safely reject this alternative is in that it would fail to

[33] As defined in Section 2.

predict increasing hazard rates, which we have shown previously to be a pervasive feature of the data[34].

More formally, these alternative mechanisms of selection or learning by doing can be accommodated in our empirical model and tested through generalized likelihood ratio tests, such as the Vuong and the Clarke specification selection tests. Such tests are specifically designed to test non-nested models in a maximum likelihood environment[35]. To see how implementing such tests is possible, consider the endogenous dismissal likelihood $\Pr\left(\sum_{\tau=1}^{t'} c(\tau) > \bar{c}\right)$. This is essentially the backbone of a cumulative shock model with a resistance threshold $\bar{c}$. Now, let us augment the process of accumulation of shocks by adding n additional shocks, $g(\tau)$, for the first $\tau \leq m$ periods in office and by adding no additional shocks after m periods. These additional early shocks essentially load risk of passing the resistance threshold $\bar{c}$ in the first few years of a minister's career and can potentially describe an early selection hazard in addition to the coup risk which is the focus of our model. The useful convolution properties of the shock distributions that we have emphasized above can be preserved if one is willing to maintain the assumption of i.i.d. exponential shocks for g. In Table 7 we consider three different instances of the selection mechanism, by imposing $n = 1, 2$, and 5 additional shocks g are added in period $m = 1$ only. This means that the hazard function can now be constructed using $\Pr\left(\sum_{\tau=1}^{t'} c(\tau) + ng(1) > \bar{c}\right)$, regulating the intensity of the selection strength by increasing n. Were the data willing to accommodate additional selection risk in the first year of office, as the Jovanovich model would imply for example, then Vuong and Clarke tests would support such an alternative relative to the simple hazard process implied by our model. As is evident from Table 7, all three alterna-

[34]This very same fact rejects as an alternative mechanism *learning by doing* on the part of ministers as well. That is, a setting in which early on in his career a ministers makes a lot of mistakes that could potentially cost him his job, but whose likelihood decreases as he gets more acquainted with his role over time. Again the predicted equilibrium hazard function would be downward sloping in analysis time under this alternative scenario (see Nagypal, 2007).

[35]The null hypotheses for both the Vuong and Clarke tests are that both our model and the alternative mechanism are true against a two-sided alternative that only one of the two models is in fact true. The Vuong test has better power properties when the density of the likelihood ratios of the baseline and the alternative is normally distributed, while the Clarke test is more powerful when this condition is violated.

tive models are rejected in favor of our baseline mechanism. All tests favor rejection with p-values less than 1 percent. Table 7 indicates that these additional mechanism play at best a second-order role.

A different selection mechanism can also be addressed. Let us assume, for instance, that a leader has only partial information about the true political quality of his ministers, but observes informative signals slowly over time. Under rational learning, the accumulation of information would imply some delay in firing ministers, due to the likely use of optimal thresholds in posterior beliefs for determining, with a sufficient degree of certainty, a rational selection criterion. This particular setup can deliver a *selection with delay* hazard function. As it takes time to assess the (initially unknown) quality of every minister in order to select the 'good' ministers and drop the 'bad', initially increasing hazards could be generated in equilibrium, while a hazard drop later on could be a simple consequence of the selection dynamics described above[36].

Where this mechanism would fail empirically is in matching two important features of the data. First is the fact that more experienced leaders tend to systematically hire more experienced ministers and less senior leaders tend to hire less experienced ministers. In fact, any model pivoting around selection incentives based on discovering the true type of a minister would likely imply a preference for more experienced ministers by both experienced and unexperienced leaders alike, for experienced ministers are, in many respects, a better known entity. This appears at variance with the data.

This last remark points to a more basic empirical flaw of selection mechanisms based on fixed ministerial types. Were low quality ministers to be discarded and high quality ones retained, a minister that had been terminated should never reappear in government. In fact, such a minister must have been terminated because her or his true type had been revealed

[36]Non-monotone hazard rates (first increasing and eventually decreasing over tenure) are common in models with job-matching where the quality of the match is unknown at the time of the match formation and is revealed over time through observing one's productivity on the job. See Jovanovic (1979, 1984) for early examples within the labor economics literature. Another stream of the literature focusing on agency problems in political environment focuses on the unwillingness of agents to reveal information, also producing non-monotonic hazard functions, as in Aghion and Jackson (2014).

with sufficient precision and s/he turned out to be bad. Contrary to such a prediction, around 33.4 percent of the ministers at the beginning of a leader's regime exhibit some previous experience in government, i.e. multiple ministerial spells. This appears somewhat at odds with the core idea of a selection mechanism.

Second, this mechanism does not provide a logical story for the finding in Figure 8 - or any break in hazards around a safe date during the leader's career.

A final reasonable alternative mechanism for the process of political appointment in neopatrimonialist systems, like the ones in Africa, is what can be referred to as the "*my turn to eat*" hypothesis.[37] In the words of van Soest (2007) "*neopatrimonial rulers frequently rotate the political elite [...] in order to extend the clientelist network*", while Snyder (1992) states that "*Mobutu's patronage network was characterized by such frequent circulation of elites that Thomas Turner likened Zaire's politics to a 'game of musical chairs'. Elite circulation atomized Zairian elites by pressuring them to focus exclusively on self-aggrandizement during the short period they had access to state power and perquisites.*" Turner and Young (1985), cited by Acemoglu, Robinson, and Verdier (2004), specifically talk with respect to Mobutu of "*Client office holders have been constantly reminded of the precariousness of tenure by the frequency of office rotation, which simultaneously fuels the hopes of those Zairians anxiously waiting just outside the portals of power*". More precisely, suppose there is a set of political elites that a country leader has to "feed" with patronage disbursements waiting on the national cabinet's sidelines and that ministerial posts precisely serve this purpose, as vastly documented (Arriola, 2009; Francois, Rainer, and Trebbi, 2015). Essentially, elites are to be assigned positions, be fed, and eventually let go. This mechanism would arguably predict initially increasing hazard rates, as it takes time to extract patronage. But again this logic struggles empirically along three dimensions. First, "*my turn to eat*" would not fit the eventual decreasing hazards, as the likelihood of a politician being satiated and let go should reasonably increase over time. Modulo additional ad-hoc mechanisms, this alternative

[37] We thank Leonard Wantchekon at Princeton University for suggesting this alternative.

interpretation would also fail to directly match why more experienced leaders tend to hire more experienced ministers, as evident in Section 2.[38] Third, it seems unclear why specific breaks in the hazards such as reported in Figure 8 should arise within this mechanism.

7 Counterfactual Exercises and Welfare

This section explores some important quantitative implications of our model. A critical implication of our theory is that the incentives for leadership survival may be playing a fundamental role in affecting the political horizons of SSA ministers. While we do not model formally how shorter horizons translate in to lower levels of political investment, there is theoretical and empirical evidence in support of this mechanism. Prominently, a vast theoretical literature pivots on myopic behavior of politicians when subject to electoral or political risk shortening their horizon (Amador, 2012; Aguiar and Amador, 2011). Empirically, Dal Bo and Rossi (2011) show precise quasi-experimental evidence of curtailed political investment in the context of the Argentine Congress.

This section explores some relevant counterfactual exercises that can guide our understanding of the quantitative drivers of average ministerial lifetimes in office. Table 8 reports four sets of counterfactuals for each country in our sample, in addition to the average minister lifetime under the baseline model (for reference).

The first parameterization we explore is an increase in the bargaining power of ministers versus the leader. We increase the technological parameter β by 10 percent of its estimated value. By reducing the gap between what is captured by the minister and the leader, leadership becomes less appealing and the loyalty of a minister easier to maintain. Intuitively, this reduces incentives for terminating insiders and the average length of office increases –sometimes substantially, as in Cameroon where it adds a full extra year in office to the typical minister. The reader may think of several policies aimed at adding value to the

[38] An example of a reasonable ad-hoc component would be a leader choosing his ministers among the set of people he knows best, e.g. his cohort. In Table 3 we have however also shown that leader's experience predicts ministerial experience even after controlling for cohort distance.

political capital and the experience of a minister in office that may slow down the setting in of diminishing returns and may increase β. These include administrative training programs or international exchanges for the requalification of top bureaucrats, for example.

Increases in the speed of coup capacity accumulation or higher likelihood of coup success (respectively, ς_c and γ,both increased by 10% of their baseline values) drastically shorten average ministerial horizons. This is a symmetric effect relative to that discussed above. By increasing the coup threat stemming from ministers, one forces leaders toward more ministerial churning, strongly reducing their political horizons (and possibly increasing political myopia). These results give perspective to the indirect political effects stemming from covert or explicit foreign interventions in the African continent during the Cold War period, many of which were reflected in aid to the planning and implementation of coups. Francois, Rainer, and Trebbi (2015) consider, for instance, the role of France in West Africa and the role of the United States and Soviet Union in drastically shaping threats to the leadership of SSA countries during the Cold War. Table 8's results strongly complement that intuition.

In the last row, Table 8 reports the effects of shortening the phase of exogenous leader fragility, t_δ. Interestingly, this reduction, by increasing the value of the leadership, makes coup threats more prominent and leads to shorter average ministerial tenures. Again, the counterfactual indicates how artificially induced stability of leaders (e.g. foreign protection of certain African strongmen, including Mobutu Sese Seko) may trickle down through the political organization of the regime.

While Table 8 emphasizes the potential drivers of ministerial churning, Table 9 reports the percent output losses due to the employment of suboptimal cabinets on the part of national leaders in our sample. The choice of weaker ministers due to their low bargaining strength is, in fact, an important feature of our model. Table 9 shows that such welfare losses can be substantial. If one were to endow every leader in each country with the most productive cabinet observed in that country over our time period and use the estimated political capital levels induced by (11), gains hovering around 30 percent of the total political output of the cabinet in a given year could be achievable. There is also vast variation in the magnitude of such welfare losses. The welfare losses range from a minimum of 16.8 percent of total output in Cote d'Ivoire to a maximum of 80.5 percent in Gabon. As we have emphasized in Section 4 of the paper, the balance of strength between the leader and the ministers is the source of these losses.

8 Conclusions

This paper studies the cabinet survival of national ministers in a sample of fifteen sub-Saharan countries since independence. We show that the hazard risks of termination of cabinet members display increasing hazard rates, particularly over the first five years in office, a strikingly different pattern from that found in the same continent for hazard risks of national leaders (which are typically decreasing in analysis time).

We show that this specific pattern of time dependency can be successfully rationalized by a model in which leaders optimally select and dismiss cabinet members based on their value (in terms of ministerial output) and on their threat as a potential replacement for the leader.

The model provides a complete parametric representation of the ministerial hazard functions, which we then estimate structurally to derive information on the bargaining problem between the leader and his ministers and on the dynamic process of coup capacity accumulation in these regimes. The fit of the model in terms of hazard risks and survival probabilities is excellent and the model performs well when pitted against several relevant theoretical alternatives. We further show that the welfare losses related to ministerial bargaining are substantial.

Overall, these findings speak directly to the debate on systematic political failure in Africa. While the continent's recent economic history is replete with political failures taking many forms, from civil conflict to patrimonialism, some of these failures have been ascribed directly to a political class that appears myopic and rapacious. This, we postulate, may just be a result of the specific institutional environment in which both ministers and leaders operate: an environment in which power is transferred through bloodshed and is particularly threatening to leaders. Such threats translate to rapidly increasing dismissal probabilities for insiders. We believe that this paper, by highlighting the role of leadership survival as central to the institutional organization of African governments, presents a novel mechanism in the analysis of political incentives in these weakly institutionalized systems.

9 Appendix

Proof of Lemma 1

Proof. Since $\widetilde{V}^m(k_i(t), t_l) \geq V^m(k_i(t), t_l)$, $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$ implies $V^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$. Minister i has incentive to mount a coup against l in period t, and will do so if $\sum_{\tau=t_i^0}^{t} c_i(\tau) \geq \bar{c}$, i.e., he has the capacity at time t. Now consider period $t-1$, and suppose that $\sum_{\tau=t_i^0}^{t-1} c_i(\tau) \geq \bar{c}$, i.e., minister i has capacity to mount a coup against l then. Since $c_i(t)$ is drawn from C, which has non-negative support, i will also have capacity to mount a coup against l in t. Thus, leader l will dismiss i from the ministry in t, since he would mount a coup with certainty if he were to remain. A minister dismissed at t will never re-enter under the current leader because, from (3), $k_i^m(k_l) = \frac{\beta_m}{1-\beta_m} k_l$, and k_l grows at $1+g$ per period, whereas a dismissed minister's capital does not grow when out of office. Consequently, minister i will attempt a coup at the end of period $t-1$. Since $i's$ coup capacity and experience are public knowledge, l will dismiss i at the start of period $t-1$. Notice that this result does not depend on the relationship between $\widetilde{V}^m(k_i(t-1), t_l)$ and $\gamma V^l(k_i(t-1), t-1)$, and follows only from $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$ and the fact of coup capacity at $t-1$. Consequently, in period $t-2$, if i has coup capacity then, he will also have it in $t-1$, and therefore in t. He will be dismissed at the start of $t-1$, and by identical reasoning, he will thus be dismissed at the start of $t-2$. The same argument can be applied to period $t-3$ and so on up to the first period, denote it t_1, at which $\sum_{\tau=t_i^0}^{t_1} c_i(\tau) \geq \bar{c}$.□

Proof of Lemma 2

Proof. Suppose $\Upsilon = \emptyset$. Then $\widetilde{V}^m(k_i(t_0), t_l) \geq \gamma V^l(k_i(t_0), t_0)$ implies $\widetilde{V}^m(k_i(t), t_l) \geq \gamma V^l(k_i(t), t)\, \forall t > t_0$. Then, provided $\widetilde{V}^m(k_i(t), t_l) = V^m(k_i(t), t_l)$ holds, minister i has never an incentive to mount a coup against l. But a necessary condition for there to exist a t such that $\widetilde{V}^m(k_i(t), t_l) > V^m(k_i(t), t_l)$ is that there exists a $\tau \geq t$ such that $\widetilde{V}^m(k_i(\tau), t_l) < \gamma V^l(k_i(\tau), \tau)$ is satisfied. However, this is not possible if $\Upsilon = \emptyset$ and $\widetilde{V}^m(k_i(t_0), t_l) \geq \gamma V^l(k_i(t_0), t_0)$, thus it must be that $\widetilde{V}^m(k_i(t), t_l) = V^m(k_i(t), t_l)$. It then follows that $V^m(k_i(t_0), t_l) \geq \gamma V^l(k_i(t_0), t_0)$ and also for all $t > t_0$, so that $\bar{T}_i = t_0$.
Suppose $\Upsilon = \emptyset$. Then $\widetilde{V}^m(k_i(t_0), t_l) < \gamma V^l(k_i(t_0), t_0)$ implies $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$ $\forall t$. This implies that $\widetilde{V}^m(k_i(t), t_l) > V^m(k_i(t), t_l)\, \forall t$. But if that is the case, then it must be that $V^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)\, \forall t$ and $\bar{T}_i$ does not exist.
Suppose now $\Upsilon \neq \emptyset$, and suppose that at $t = \sup \Upsilon$ it is the case that $\widetilde{V}^m(k_i(t), t_l) \geq \gamma V^l(k_i(t), t)$. Then, necessarily, because t is $\sup \Upsilon$, it must be that $\widetilde{V}^m(k_i(\tau), t_l) \geq \gamma V^l(k_i(\tau), \tau)\ \forall \tau > t$. But then, necessarily, $\widetilde{V}^m(k_i(\tau), t_l) = V^m(k_i(\tau), t_l)\ \forall \tau > t$, so it follows that $V^m(k_i(\tau), t_l) \geq \gamma V^l(k_i(\tau), \tau)\ \forall \tau > t$. This proves that then, beyond $\sup \Upsilon$, i will never mount a coup against l. However, for $\hat{\tau} = \sup \Upsilon - 1$, by the definition of $\sup \Upsilon$ and the supposition that at $t = \sup \Upsilon$ the condition $\widetilde{V}^m(k_i(t), t_l) \geq \gamma V^l(k_i(t), t)$ is verified, it must be that $\widetilde{V}^m(k_i(\hat{\tau}), t_l) < \gamma V^l(k_i(\hat{\tau}), \hat{\tau})$. Thus it follows directly from Lemma 1 that i will mount a coup against l at $\hat{\tau}$ and at all earlier dates, if he happens to have accumulated sufficient capacity to do so. Consequently $\bar{T}_i = \sup \Upsilon$.
Suppose $\Upsilon \neq \emptyset$, and suppose instead that at $t = \sup \Upsilon$ it is the case that $\widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$. Then, necessarily, we have that $V^m(k_i(t), t_l) < \widetilde{V}^m(k_i(t), t_l) < \gamma V^l(k_i(t), t)$,

implying that i will mount a coup against l at $t = \sup \Upsilon$ if he has the capacity to do so. It also follows from the definition of $\sup \Upsilon$ that $V^m(k_i(\tau), t_l) < \widetilde{V}^m(k_i(\tau), t_l) < \gamma V^l(k_i(\tau), \tau)$ $\forall \tau > t$. It follows directly from Lemma 1 that i will mount a coup against l at all $\tau < t = \sup \Upsilon$ if he has the capacity to do so. Consequently $\bar{T}_i$ does not exist.

Finally, consider the case of the set of crossing points Υ being infinite. Then, at any point where there is capacity to undertake a coup, the coup will be taken. This is because there always exists a future point at which the minister will be dismissed, i.e. the next point at which the value of being a leader is higher. So, he would be dismissed by the leader before reaching that point. Knowing this, he will preempt this dismissal with a coup, but then again he would be dismissed earlier, and so on.□

Proof of Proposition 2

Proof. Since leaders have full information, if (6) fails, then minister i is not a threat, has optimal k, and will not be terminated given ε costs. If (6) holds, the minister can mount a coup. The leader then considers i's incentive to mount a coup. From Lemma 2, this amounts to comparing t to the safe date $\bar{T}_i$, which directly implies termination if and only if the inequality in the statement of the proposition holds.□

Proof of Proposition 3

Proof. At any analysis time $t' \geq \bar{T}'$ the minister is safe and his hazard is flat at $1-\sigma$. At any analysis time $t' < \bar{T}'$ hazard risk 1 increments are governed by either $c(t')$ or $M_s c(t')$ depending on the ministerial type. Without loss of generality assume $M_s = 1$. We can then indicate the change of the hazard risk 1 as driven by $\Pr\left(\sum_{\tau=1}^{t_i'+1} c(\tau) \leq \bar{c} \middle| \sum_{\tau=1}^{t_i'} c(\tau) \leq \bar{c}\right) - \Pr\left(\sum_{\tau=1}^{t_i'} c(\tau) \leq \bar{c} \middle| \sum_{\tau=1}^{t_i'-1} c(\tau) \leq \bar{c}\right)$. The hypothesis in point 1 is that this difference is negative. Notice that

$$\Pr\left(\sum_{\tau=1}^{t_i'+1} c(\tau) \leq \bar{c} \middle| \sum_{\tau=1}^{t_i'} c(\tau) \leq \bar{c}\right) = \frac{\Pr\left(\sum_{\tau=1}^{t_i'+1} c(\tau) \leq \bar{c}\right)}{\Pr\left(\sum_{\tau=1}^{t_i'} c(\tau) \leq \bar{c}\right)}.$$

Hence we need to show that $\frac{\Pr\left(\sum_{\tau=1}^{t_i'+1} c(\tau)\leq\bar{c}\right)}{\Pr\left(\sum_{\tau=1}^{t_i'} c(\tau)\leq\bar{c}\right)} < \frac{\Pr\left(\sum_{\tau=1}^{t_i'} c(\tau)\leq\bar{c}\right)}{\Pr\left(\sum_{\tau=1}^{t_i'-1} c(\tau)\leq\bar{c}\right)}$.

Define the partial sum of random variables $X_{t'} = \sum_{\tau=1}^{t'} c(\tau) \sim \mathit{Gamma}(t', \varsigma_c)$, where t' is the Gamma's shape, and is a positive integer, and ς_c its scale. This implies $F_{t'}(x) = \Pr(X_{t'} \leq x) = e^{-\frac{x}{\varsigma_c}} \sum\limits_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{x}{\varsigma_c}\right)^i$ (as the distribution is, more properly, Erlang). Since $f_{t'}(x) = \frac{x^{t'-1}e^{-\frac{x}{\varsigma_c}}}{\varsigma_c^{t'}(t'-1)!}$, then $f_{t'+1}(x)/f_{t'}(x) = \frac{x}{\varsigma_c t'}$. Hence, $f_{t'}(x)/f_{t'-1}(x) > f_{t'+1}(x)/f_{t'}(x)$ and in addition, for any $x_1 > x_0$, it must be that $f_{t'}(x_1)/f_{t'-1}(x_1) > f_{t'}(x_0)/f_{t'-1}(x_0)$. So,

$$f_{t'}(x_1)\, f_{t'-1}(x_0) > f_{t'-1}(x_1)\, f_{t'}(x_0).$$

Integrating both sides of this last inequality to x_1 with respect to x_0 we get

$$\begin{aligned}
\int_{\min x}^{x_1} f_{t'}(x_1) f_{t'-1}(x_0)\,dx_0 &> \int_{\min x}^{x_1} f_{t'-1}(x_1) f_{t'}(x_0)\,dx_0 \\
\frac{f_{t'}(x_1)}{f_{t'-1}(x_1)} &> \frac{F_{t'}(x_1)}{F_{t'-1}(x_1)}
\end{aligned}$$

Hence, for any x, $\frac{f_{t'}(x)}{f_{t'-1}(x)} > \frac{F_{t'}(x)}{F_{t'-1}(x)}$ and

$$\frac{f_{t'+1}(x)}{f_{t'}(x)} > \frac{F_{t'+1}(x)}{F_{t'}(x)}. \tag{12}$$

Recall that we need to prove:

$$\frac{F_{t'+1}(\bar{c})}{F_{t'}(\bar{c})} = \frac{\sum_{i=t'+1}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i}{\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i} < \frac{F_{t'}(\bar{c})}{F_{t'-1}(\bar{c})} = \frac{\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i}{\sum_{i=t'-1}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i}$$

or

$$\left(\sum_{i=t'+1}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i\right)\left(\sum_{i=t'-1}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i\right) < \left(\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i\right)^2.$$

Suppose, ad absurdum, this last condition is false, that is $\frac{F_{t'+1}(\bar{c})}{F_{t'}(\bar{c})} > \frac{F_{t'}(\bar{c})}{F_{t'-1}(\bar{c})}$, or:

$$\begin{aligned}
\left(\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i - \frac{1}{t'!}\left(\frac{\bar{c}}{\varsigma_c}\right)^{t'}\right)\left(\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i + \frac{1}{(t'-1)!}\left(\frac{\bar{c}}{\varsigma_c}\right)^{t'-1}\right) - \left(\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i\right)^2 &> 0 \\
&\therefore \\
\left(\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i\right)\left(\frac{1}{(t'-1)!}\left(\frac{\bar{c}}{\varsigma_c}\right)^{t'-1} - \frac{1}{t'!}\left(\frac{\bar{c}}{\varsigma_c}\right)^{t'}\right) - \left(\frac{1}{t'!}\left(\frac{\bar{c}}{\varsigma_c}\right)^{t'}\right)\left(\frac{1}{(t'-1)!}\left(\frac{\bar{c}}{\varsigma_c}\right)^{t'-1}\right) &> 0 \\
&\therefore \\
\left(\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i\right) t' \left(\frac{\bar{c}}{\varsigma_c}\right)^{-1} - \left(\sum_{i=t'-1}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i\right) &> 0 \\
&\therefore \\
\frac{\sum_{i=t'}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i}{\sum_{i=t'-1}^{\infty} \frac{1}{i!}\left(\frac{\bar{c}}{\varsigma_c}\right)^i} &> \frac{\bar{c}}{t'\varsigma_c} \\
&\therefore \\
\frac{F_{t'}(\bar{c})}{F_{t'-1}(\bar{c})} &> \frac{f_{t'+1}(\bar{c})}{f_{t'}(\bar{c})}
\end{aligned}$$

But then, using this last result and (12), it follows that:

$$\frac{F_{t'}\left(\bar{c}\right)}{F_{t'-1}\left(\bar{c}\right)} > \frac{f_{t'+1}\left(\bar{c}\right)}{f_{t'}\left(\bar{c}\right)} > \frac{F_{t'+1}\left(\bar{c}\right)}{F_{t'}\left(\bar{c}\right)}$$

which is a contradiction. This implies point 1 of the proposition.

All other points are proven by inspection.□

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Table 1: African Cabinets - Summary Statistics by Country

Country	Time Period Covered	Years Missing	Years with Two Governments	Number of Governments	Number of Leaders in Power	Number of Government-Ministers	Average Size of Government (# posts)	Total Number of Unique Ministers	Average Number of Governments per Minister
Benin	1960-2004	1969, 1975	1968, 1970	45	10	730	16.22	209	3.49
Cameroon	1960-2004	1969, 1975	1968	44	2	1445	32.84	262	5.52
Cote d'Ivoire	1960-2004	1975	1970	45	4	1256	27.91	233	5.39
Dem. Rep. Congo	1961-2004	1972, 1974	1970, 1973	44	4	1352	30.73	515	2.63
Gabon	1960-2004	1975		44	2	1173	26.66	185	6.34
Ghana	1960-2004	1975	1970	45	9	1140	25.33	362	3.15
Guinea	1960-2004	1975	1969	45	2	1213	26.96	244	4.97
Kenya	1964-2004	1975	1970	41	3	1010	24.63	155	6.52
Liberia	1960-2004	1975	1970	45	10	938	20.84	272	3.45
Nigeria	1961-2004	1975	1970	44	11	1499	34.07	473	3.17
Rep. of Congo	1960-2004	1969, 1975	1968, 1970	45	7	918	20.40	239	3.84
Sierra Leone	1960-2004	1972, 1975	1970, 1973	45	9	1109	24.64	288	3.85
Tanzania	1965-2004	1972, 1974	1970, 1973	40	3	1016	25.40	158	6.43
Togo	1960-2004	1975	1970	45	3	757	16.82	199	3.80
Uganda	1963-2004	1972, 1974	1970, 1973	42	6	1037	24.69	205	5.06

Notes: In the "Number of Leaders in Power" column, we count a new nonconsecutive term in office of the same leader as a new leader. Source: Rainer and Trebbi (2011).

Table 2: Summary Statistics for Durations

Variable	N. Obs.	Average	Min	Max
Leadership Spells Sample (All Africa)				
Initial Year	262	1980.084	1941	2004
Spell Durationn	262	8.40458	1	40
Censored	262	0.145038	0	1
Leadership Spells Sample				
Initial Year	85	1978.871	1960	2004
Spell Durationn	85	7.788235	1	38
Censored	85	0.176471	0	1
Ministerial Spells Sample				
Initial Year	5009	1983.994	1960	2004
Spell Durationn	5009	3.185067	1	31
Censored	5009	0.092234	0	1
Risk 1 Exit	5009	0.593931	0	1
Risk 2 Exit	5009	0.313835	0	1

Table 3: Minister's and Leader's Experience at Regime Start

Dependent variable: Minister's Experience at Start.

	(1)	(2)	(3)	(4)	(5)	(6)
Leader's Experience at Start	0.174 (0.043)	0.172 (0.043)	0.159 (0.044)	0.307 (0.057)	0.089 (0.040)	0.215 (0.045)
Cohort Distance from Leader				-0.055 (0.023)		-0.069 (0.023)
Ethnic Distance from Leader				-0.375 (0.593)		-0.520 (0.480)
Top Cabinet Position		0.623 (0.158)	0.780 (0.200)	0.693 (0.259)	0.499 (0.151)	0.507 (0.235)
Sample Post-1975	N	N	Y	N	N	N
Country F.E.	N	N	N	N	Y	Y
Observations	1643	1643	1275	778	1643	778

Notes: Only cabinets at regime start are considered. Clustered standard errors in parentheses below coefficients. Clustering at the Leader's identity level. Cohort Distance = absolute value of Year of Birth of Minister – Year of Birth of Leader; Ethnic Distance = ethnolinguistic distance between minister and leader based on number of Ethnologue branches.

Table 4: Hazard Time Dependency Before and After the Leader's Safe Date

Safe Date	**Before the Safe Date**		**After the Safe Date**	
(Years After Leader's Start)	Coeff.	s.e.	Coeff.	s.e.
8	0.29	(0.03)	-0.42	(0.09)
9	0.30	(0.03)	-1.00	(0.05)
10	0.12	(0.07)	-0.88	(0.05)
11	0.24	(0.05)	-0.72	(0.06)
12	0.25	(0.04)	-0.36	(0.10)
13	0.22	(0.03)	-0.48	(0.09)
14	0.18	(0.04)	-0.30	(0.06)

Notes: The table reports linear coefficients of the nonparametric hazard of termination regressed on ministerial tenure in office. In the "Before" panel we consider any minister who starts before the leader reaches the safe date in years of tenure and we censor all ministerial spells at the year when the leader reaches the safe date. In the "After" panel we consider any minister who is terminated after the safe date or starts and finishes after the safe date. All countries excluding the Dem. Rep. of Congo. Clustered standard errors in parentheses next to coefficients. Clustering at the country-year level.

Table 5: Likelihood of Exit Increases with Tenure Before the Leader's Safe Date

	Safe Date (Years After Leader's Start)						
	8	9	10	11	12	13	14
Minister's Tenure is:							
2	.036	.040	.044	.044	.044	.045	.044
	(.019)	(.019)	(.019)	(.018)	(.018)	(.018)	(.018)
3	.045	.048	.049	.042	.043	.041	.044
	(.024)	(.023)	(.023)	(.023)	(.022)	(.021)	(.021)
4	.049	.054	.056	.057	.053	.048	.050
	(.026)	(.025)	(.024)	(.024)	(.023)	(.022)	(.022)
5	.026	.032	.034	.043	.044	.043	.040
	(.025)	(.025)	(.024)	(.023)	(.023)	(.022)	(.021)
6	.087	.076	.081	.092	.092	.090	.083
	(.031)	(.029)	(.029)	(.029)	(.028)	(.028)	(.027)
7	.075	.090	.080	.080	.082	.074	.074
	(.038)	(.037)	(.035)	(.034)	(.032)	(.030)	(.030)
8	-.039	.024	.022	.020	.030	.025	.027
	(.042)	(.038)	(.036)	(.032)	(.033)	(.032)	(.031)
9		-.017	-.017	.002	.010	.009	.010
		(.053)	(.050)	(.043)	(.041)	(.040)	(.038)
10			.098	.026	.035	.028	.025
			(.059)	(.054)	(.050)	(.043)	(.042)
11				.005	-.004	.005	.004
				(.072)	(.059)	(.056)	(.052)
12					.086	.108	.082
					(.116)	(.077)	(.014)
13						.059	.089
						(.088)	(.070)
14							.035
							(.064)
Country-Year F.E.	Y	Y	Y	Y	Y	Y	Y
Controls	Y	Y	Y	Y	Y	Y	Y
Observations	3674	3924	4144	4392	4565	4770	4916

Notes: The table reports linear coefficients of the probability of exit regressed on ministerial tenure in office. For each safe date we consider any minister who starts before the leader reaches the safe date in years of tenure. All countries excluding the Dem. Rep. of Congo. All regressions include country-year fixed effects and controls for top positions, ethnic distance from leader, and year of birth distance from leader. Clustered standard errors in parentheses under coefficients. Clustering at the country-year level.

Table 6a: All Ministers. Maximum Likelihood Estimates

	Benin	s.e.	Camero-on	s.e.	Congo Dem. Rep.	s.e.	Cote d'Ivoire	s.e.
β	0.0554	0.0002	0.0554	0.0002	0.0554	0.0002	0.0554	0.0002
ς_c	0.5639	0.1356	0.3603	0.0214	0.6062	0.3463	0.5415	0.0894
t_δ	15.0000	0.2034	15.0000	0.2034	15.0000	0.2034	15.0000	0.2034
ζ	0.0567	0.0002	0.0567	0.0002	0.0567	0.0002	0.0567	0.0002
logLL	587.807	-	803.936	-	1063.42	-	665.365	-

	Gabon	s.e.	Ghana	s.e.	Guinea	s.e.	Kenya	s.e.
β	0.0554	0.0002	0.0554	0.0002	0.0554	0.0002	0.0554	0.0002
ς_c	0.3866	0.1234	0.5510	0.0812	0.3443	0.0247	1.2319	0.8232
t_δ	15.0000	0.2034	15.0000	0.2034	15.0000	0.2034	15.0000	0.2034
ζ	0.0567	0.0002	0.0567	0.0002	0.0567	0.0002	0.0567	0.0002
logLL	620.669	-	944.615	-	748.389	-	579.325	-

	Liberia	s.e.	Nigeria	s.e.	Rep. of Congo	s.e.	Sierra Leone	s.e.
β	0.0554	0.0002	0.0554	0.0002	0.0554	0.0002	0.0554	0.0002
ς_c	0.4788	0.0362	0.8327	0.1009	0.5199	0.0616	0.1847	0.0554
t_δ	15.0000	0.2034	15.0000	0.2034	15.0000	0.2034	15.0000	0.2034
ζ	0.0567	0.0002	0.0567	0.0002	0.0567	0.0002	0.0567	0.0002
logLL	832.763	-	1332.30	-	721.239	-	878.019	-

	Tanzan-ia	s.e.	Togo	s.e.	Uganda	s.e.
β	0.0554	0.0002	0.0554	0.0002	0.0554	0.0002
ς_c	0.1787	0.0207	0.2583	0.6292	0.2842	0.0265
t_δ	15.0000	0.2034	15.0000	0.2034	15.0000	0.2034
ζ	0.0567	0.0002	0.0567	0.0002	0.0567	0.0002
logLL	603.696	-	487.196	-	660.708	-

Notes: The logLL reported is specific to the contribution of the country.

Table 6b: All Ministers Maximum Likelihood Estimates

	Benin		**Camero -on**		**Congo Dem. Rep.**		**Cote d'Ivoire**	
γ for leader:	lower	upper	lower	upper	lower	upper	lower	upper
1	0.0019	0.0021	0.0010	0.0010	0.0005	1.0000	0.0013	0.0013
2	0.0000	0.0019	0.0013	0.0013	0.0004	0.0004	0.0000	0.0011
3	0.0019	1.0000	-	-	0.0005	1.0000	0.0000	1.0000
4	0.0000	1.0000	-	-	0.0004	0.0005	0.0012	0.0012
5	0.0000	1.0000	-	-	-	-	-	-
6	0.0000	1.0000	-	-	-	-	-	-
7	0.0000	0.0019	-	-	-	-	-	-
8	0.0021	0.0022	-	-	-	-	-	-
9	0.0023	1.0000	-	-	-	-	-	-
10	0.0021	0.0022	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-

	Gabon		**Ghana**		**Guinea**		**Kenya**	
γ for leader:	lower	upper	lower	upper	lower	upper	lower	upper
1	0.0015	1.0000	0.0013	0.0014	0.0013	0.0013	0.0000	0.0012
2	0.0012	0.0013	0.0000	0.0012	0.0016	0.0016	0.0012	0.0013
3	-	-	0.0000	1.0000	-	-	0.0000	0.0012
4	-	-	0.0012	1.0000	-	-	-	-
5	-	-	0.0015	1.0000	-	-	-	-
6	-	-	0.0000	1.0000	-	-	-	-
7	-	-	0.0000	0.0012	-	-	-	-
8	-	-	0.0014	0.0014	-	-	-	-
9	-	-	0.0000	0.0012	-	-	-	-
10	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-

	Liberia		Nigeria		Rep. of Congo		Sierra Leone	
γ for leader:	lower	upper	lower	upper	lower	upper	lower	upper
1	0.0016	0.0016	0.0000	0.0009	0.0015	0.0016	0.0014	1.0000
2	0.0015	0.0016	0.0000	1.0000	0.0018	1.0000	0.0000	0.0012
3	0.0018	0.0019	0.0009	0.0009	0.0020	0.0020	0.0000	1.0000
4	0.0000	0.0015	0.0009	0.0009	0.0000	0.0015	0.0017	1.0000
5	0.0000	1.0000	0.0000	0.0009	0.0000	0.0015	0.0014	0.0014
6	0.0000	1.0000	0.0000	0.0009	0.0016	0.0017	0.0014	1.0000
7	0.0000	1.0000	0.0000	0.0009	0.0015	0.0016	0.0000	1.0000
8	0.0017	0.0018	0.0000	1.0000	-	-	0.0000	1.0000
9	0.0000	1.0000	0.0009	0.0009	-	-	0.0014	0.0015
10	0.0000	1.0000	0.0000	1.0000	-	-	-	-
11	-	-	0.0010	0.0011	-	-	-	-

	Tanzan-ia		Togo		Uganda	
γ for leader:	lower	upper	lower	upper	lower	upper
1	0.0016	0.0016	0.0018	0.0019	0.0014	0.0014
2	0.0015	0.0016	0.0020	1.0000	0.0015	0.0016
3	0.0015	0.0015	0.0026	1.0000	0.0000	1.0000
4	-	-	-	-	0.0000	1.0000
5	-	-	-	-	0.0000	0.0012
6	-	-	-	-	0.0015	0.0015
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-

Notes: Upper and lower bounds for the probability of coup success are reported.

Table 7: Tests of model with n selection shocks relative to 0 selection shocks

#shocks	Vuong statistic	p-value	Clarke statistic	p-value
1.0000	2.7284	0.0064	2658.0000	0.0000
2.0000	3.1962	0.0014	2799.0000	0.0000
5.0000	5.2407	0.0000	2842.0000	0.0000

Table 8: Average minister lifetimes under counterfactual parameterizations

Counterfactuals	Benin	Camero -on	Congo Dem. Rep.	Cote d'Ivoire	Gabon	Ghana	Guinea	Kenya	Liberia
Baseline	2.89	5.34	2.22	4.69	5.69	2.90	5.01	5.67	2.76
β increases by 10%	3.12	6.32	2.28	5.24	5.88	3.09	6.03	6.06	3.12
ς_c increases by 10%	2.86	5.20	2.21	4.63	5.53	2.83	4.90	5.68	2.71
γ increases by 10%	2.61	3.99	2.16	4.21	5.43	2.64	4.01	5.02	2.41
t_δ decreases to 12	2.77	4.12	2.15	4.31	5.53	2.78	4.17	5.36	2.46

Counterfactuals	Nigeria	Rep. of Congo	Sierra Leone	Tanzan -ia	Togo	Uganda
Baseline	2.61	3.21	3.09	5.16	3.47	3.72
β increases by 10%	2.91	3.59	3.13	5.75	3.47	4.21
ς_c increases by 10%	2.58	3.13	3.00	4.98	3.28	3.66
γ increases by 10%	2.23	2.83	3.00	4.06	3.45	3.30
t_δ decreases to 12	2.38	2.96	3.02	4.06	3.44	3.46

Table 9: Output losses

	Benin	Camero-on	Congo Dem. Rep.	Cote d'Ivoire	Gabon	Ghana	Guinea	Kenya	Liberia
Percentage	25.6	48.8	35.8	16.8	80.5	19.3	46.3	53.1	36.0

	Nigeria	Rep. of Congo	Sierra Leone	Tanzan-ia	Togo	Uganda
Percentage	27.4	42.3	33.1	36.8	72.9	31.3

Notes: Actual output as a percentage of counterfactual output levels under the most productive cabinet observed in the country over period 1960-2004 are reported.

Figure 1

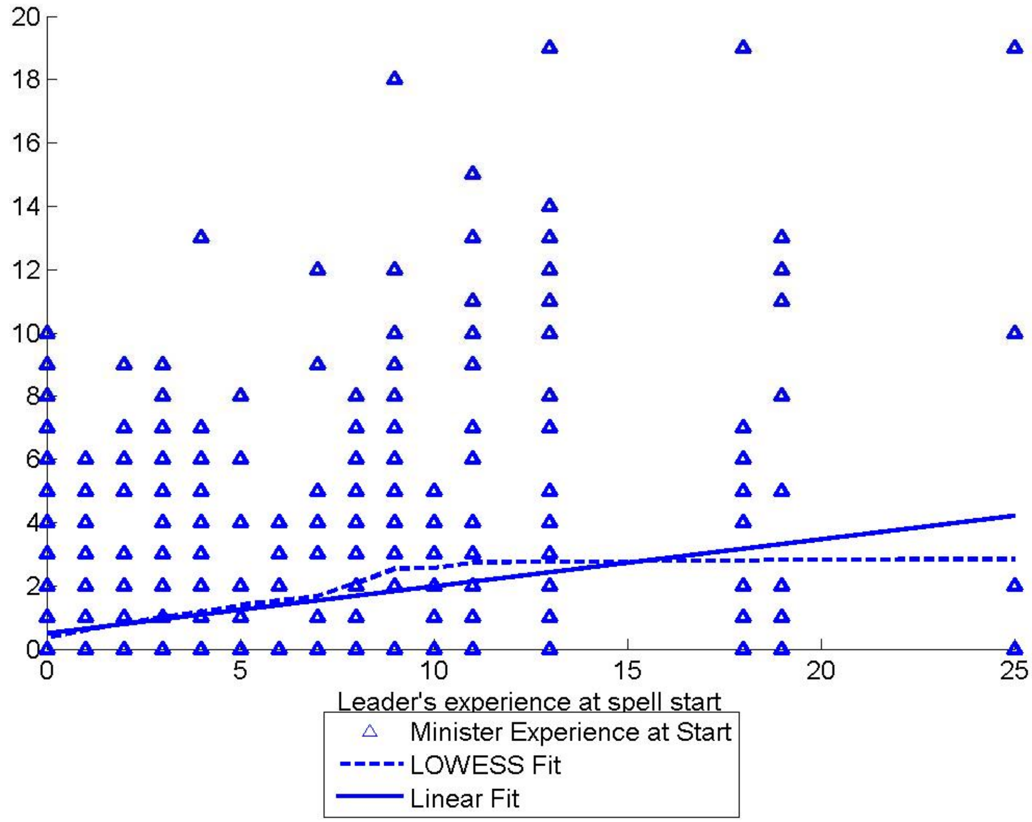
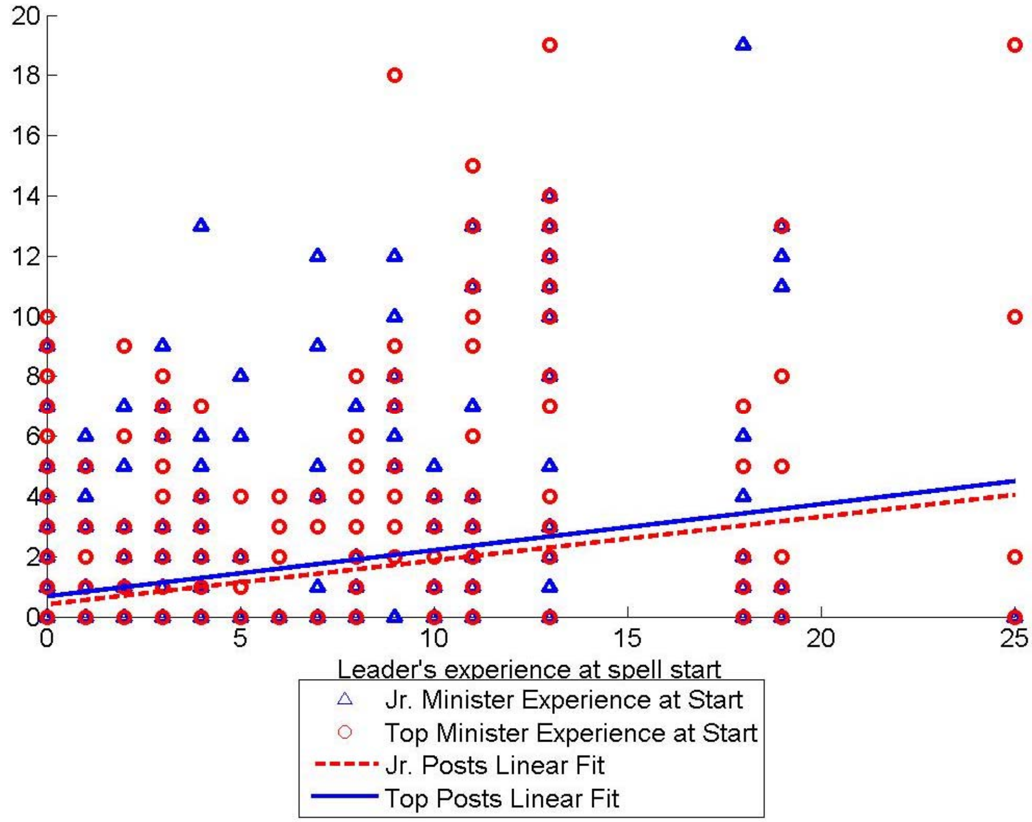

0
2
4
6
8
10
12
14
16
18
20
0
5
10
15
20
25
Leader's experience at spell start
Minister Experience at Start
LOWESS Fit
Linear Fit

Figure 2



20
18
16
14
12
10
8
6
4
2
0
0
5
10
15
20
25
Leader's experience at spell start
Jr. Minister Experience at Start
Top Minister Experience at Start
Jr. Posts Linear Fit
Top Posts Linear Fit

Figure 3

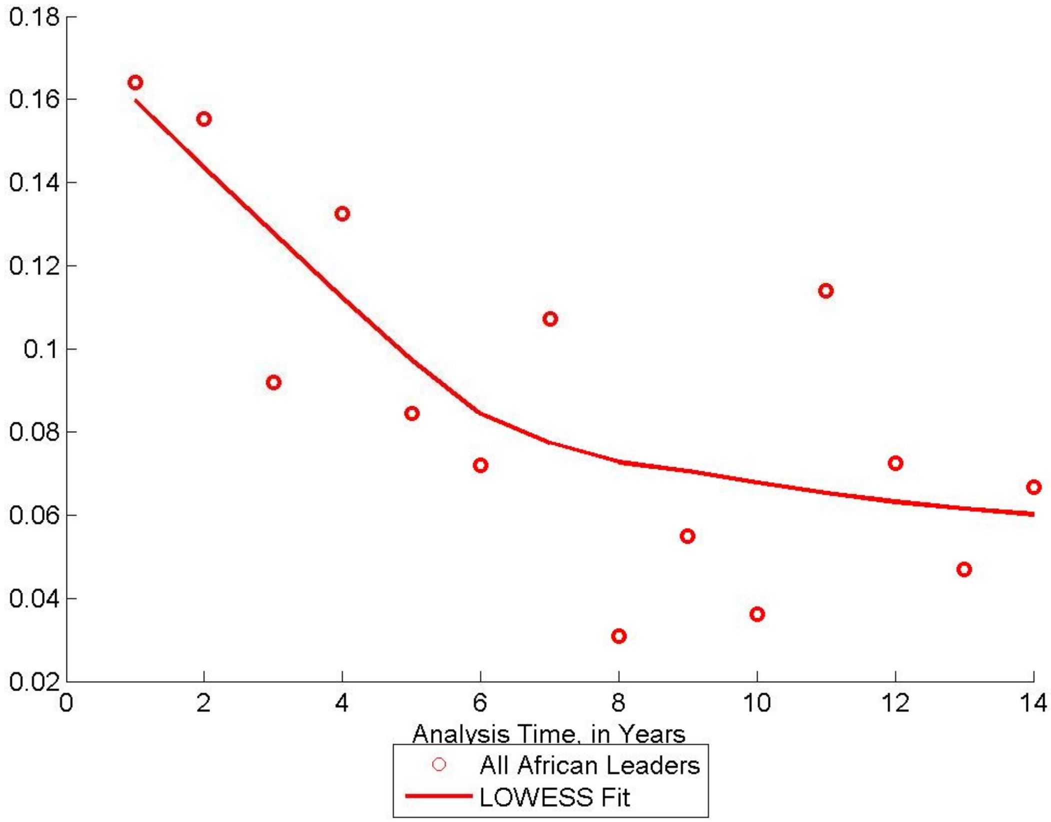

0.18
0.16
0.14
0.12
0.1
0.08
0.06
0.04
0.02
0
2
4
6
8
10
12
14
Analysis Time, in Years
All African Leaders
LOWESS Fit

Figure 4

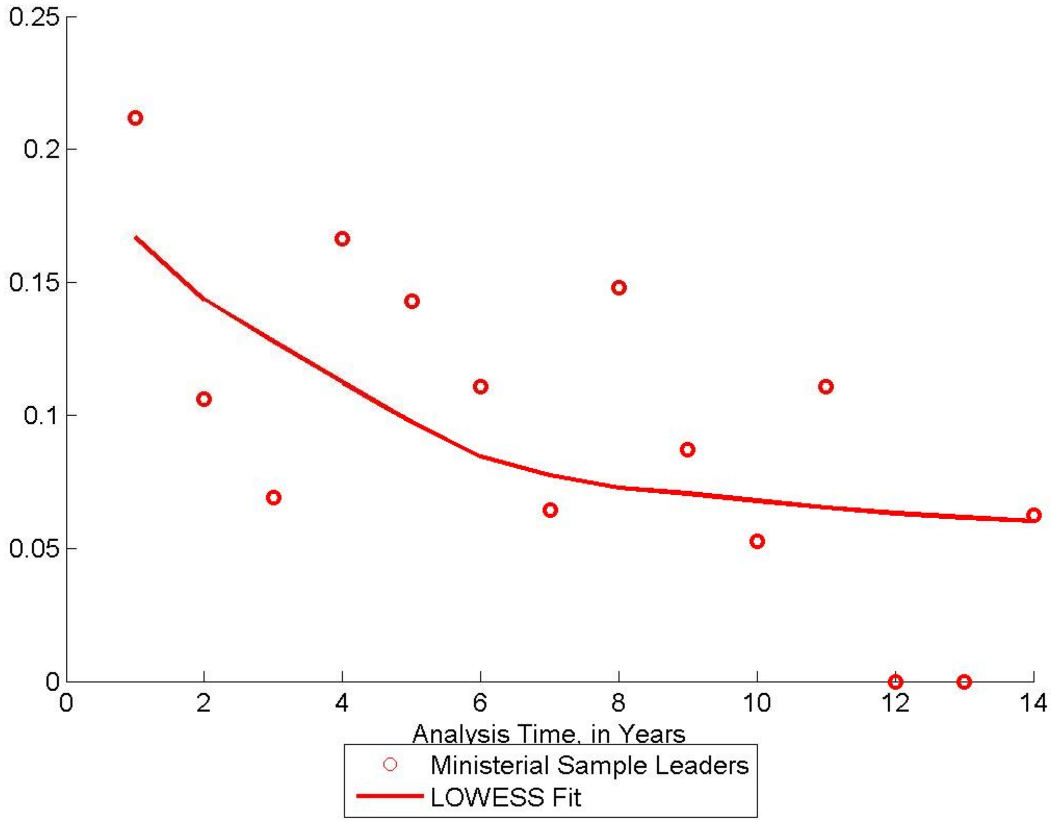
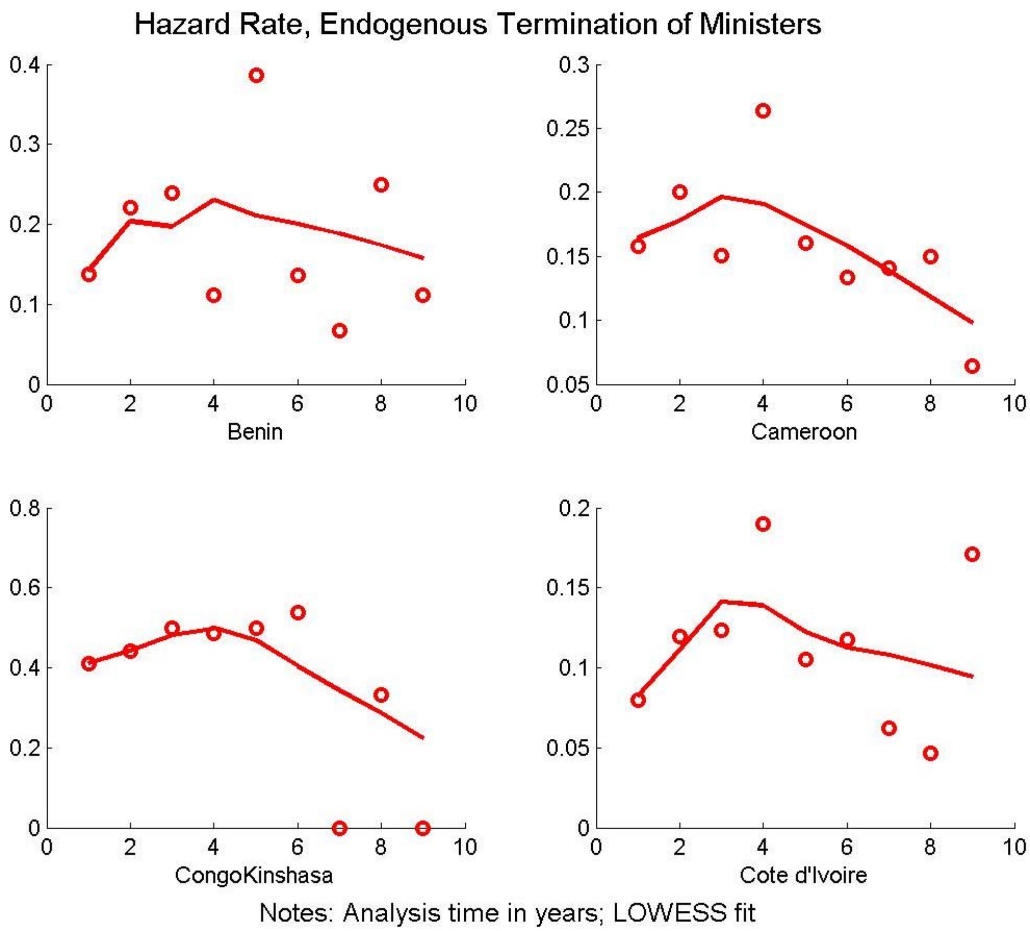

0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
12
14
Analysis Time, in Years
Ministerial Sample Leaders
LOWESS Fit

Figure 5a



Hazard Rate, Endogenous Termination of Ministers
0.4
0.3
0.2
0.1
0
0
2
4
6
8
10
Benin
0.3
0.25
0.2
0.15
0.1
0.05
Cameroon
0.8
0.6
0.4
0.2
CongoKinshasa
0.2
0.15
0.1
0.05
Cote d'Ivoire
Notes: Analysis time in years; LOWESS fit

Figure 5b

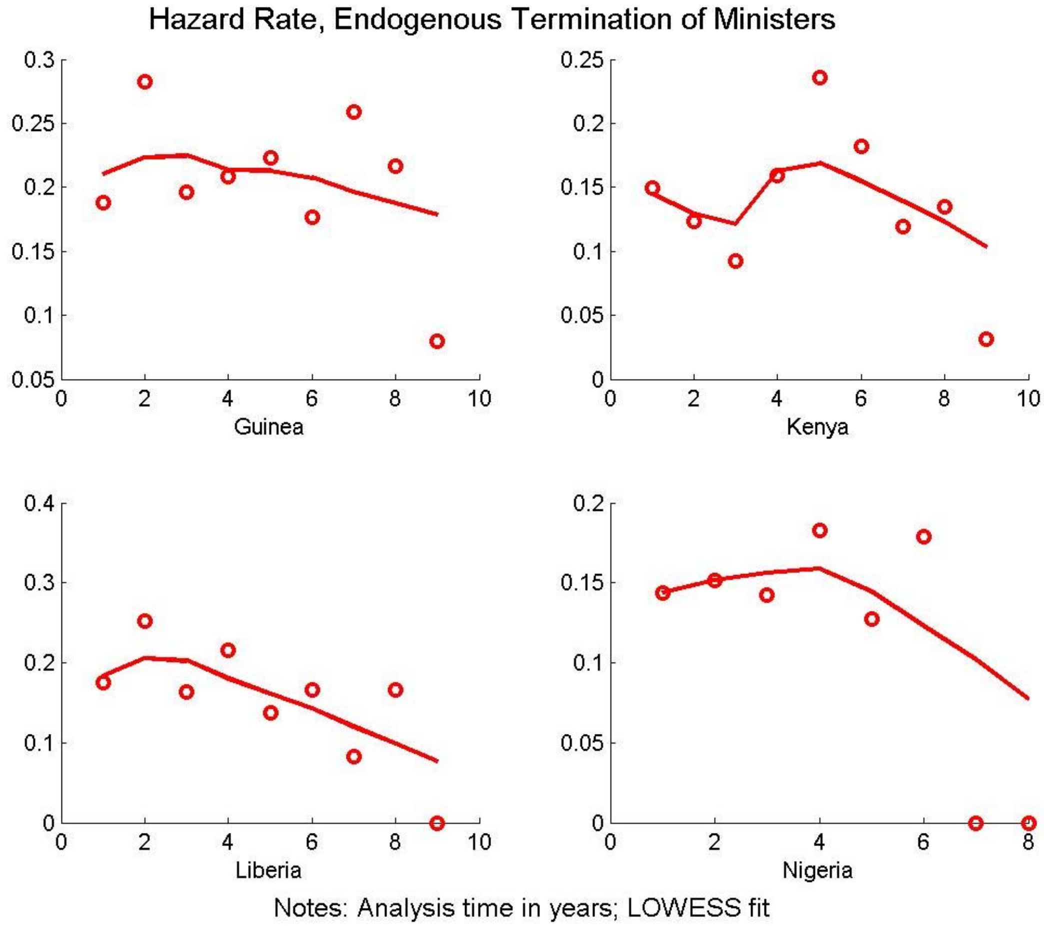

Hazard Rate, Endogenous Termination of Ministers
0.3
0.25
0.2
0.15
0.1
0.05
0 2 4 6 8 10
Guinea
0.25
0.2
0.15
0.1
0.05
0
0 2 4 6 8 10
Kenya
0.4
0.3
0.2
0.1
0
0 2 4 6 8 10
Liberia
0.2
0.15
0.1
0.05
0
0 2 4 6 8
Nigeria
Notes: Analysis time in years; LOWESS fit

Figure 5c

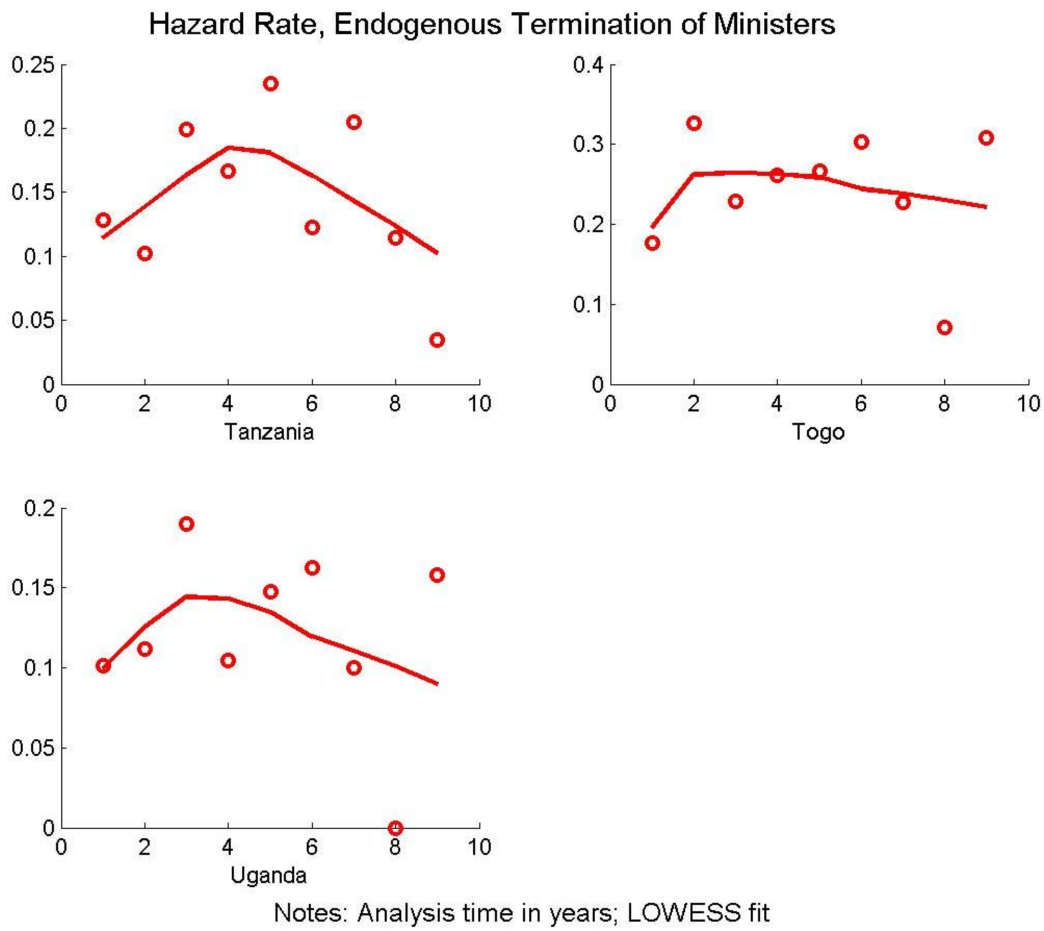

Hazard Rate, Endogenous Termination of Ministers
0.25
0.2
0.15
0.1
0.05
0
0
2
4
6
8
10
Tanzania
0.4
0.3
0.2
0.1
0
Togo
0.2
0.15
0.1
0.05
Uganda
Notes: Analysis time in years; LOWESS fit

Figure 5d

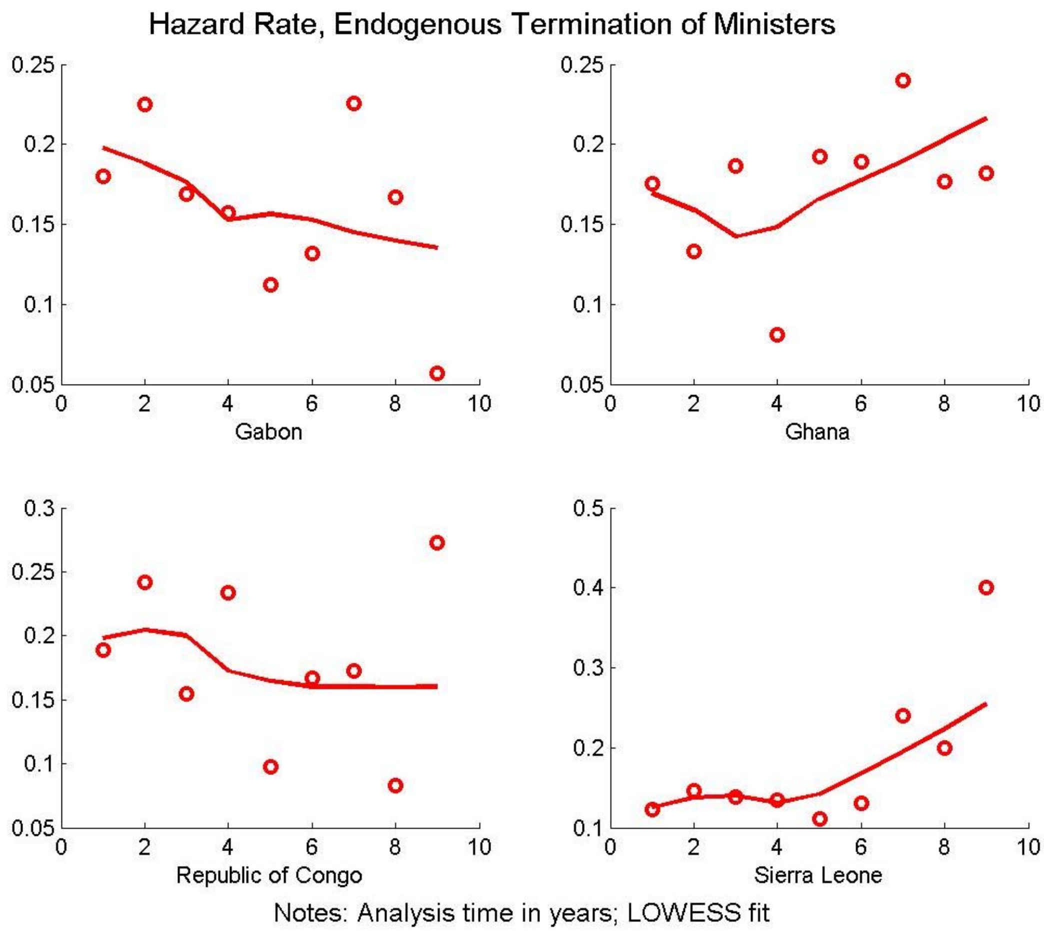


Figure 6: Timing

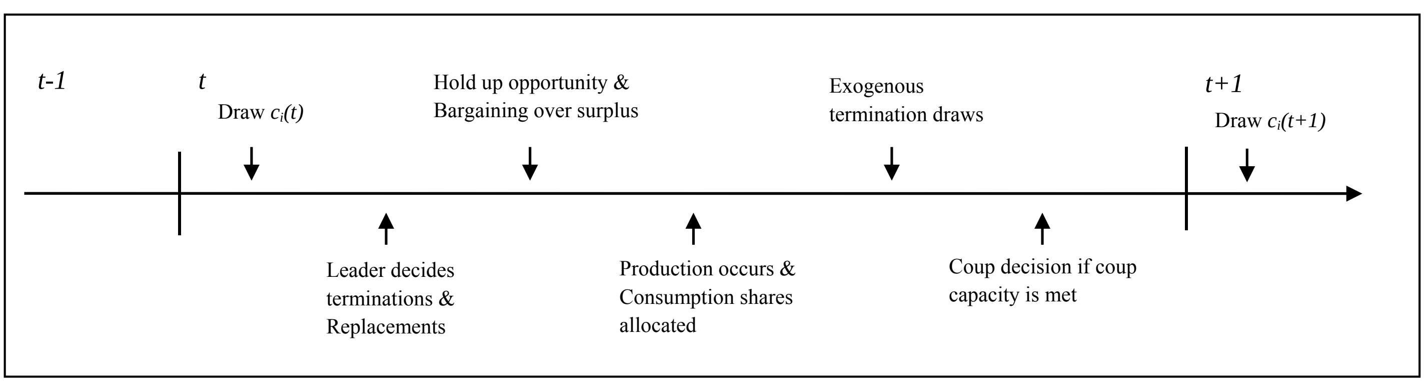


Figure 7

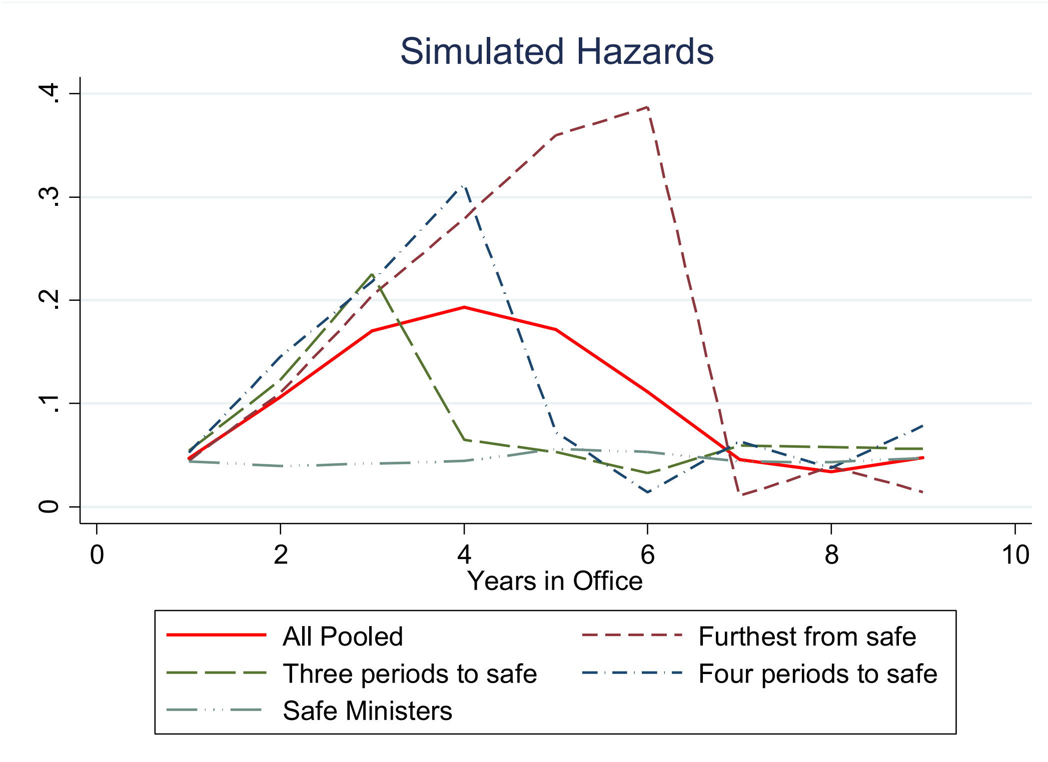
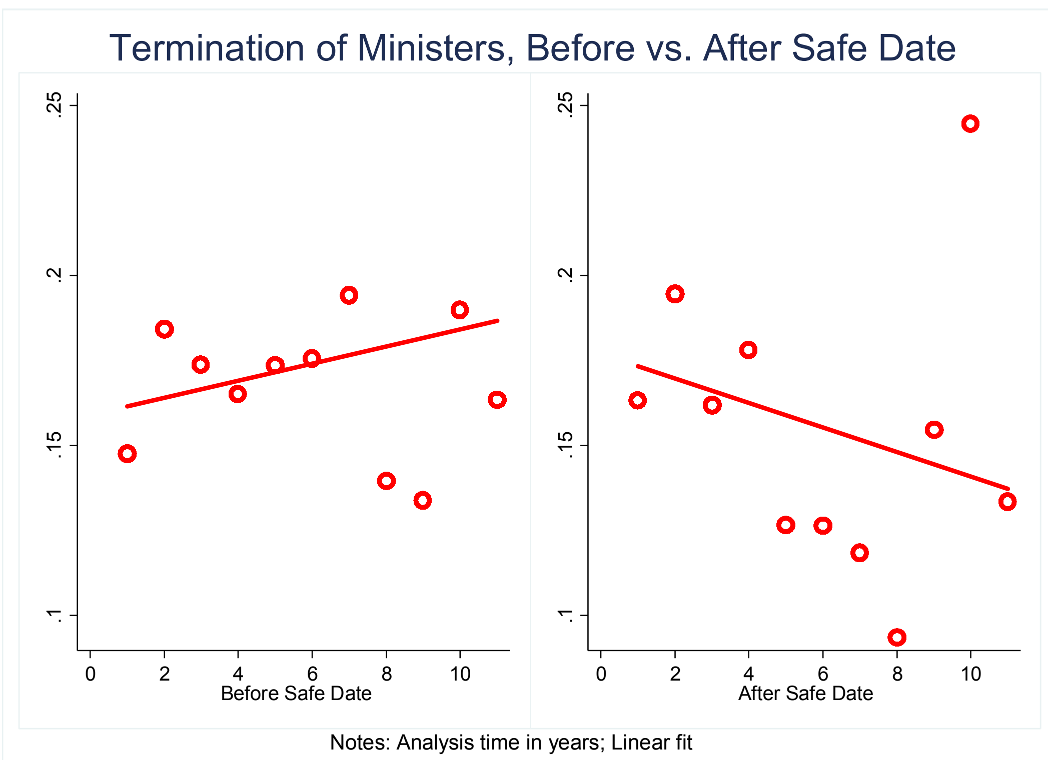


Figure 8



Appendix Table A1a: Senior Ministers Maximum Likelihood Estimates

	Benin	s.e.	Camero -on	s.e.	Congo Dem. Rep.	s.e.	Cote d'Ivoire	s.e.
β	0.1033	0.0006	0.1033	0.0006	0.1033	0.0006	0.1033	0.0006
ς_c	0.4808	0.1751	0.2784	0.0260	0.3444	0.5415	0.7392	0.3254
t_δ	15.0000	0.4453	15.0000	0.4453	15.0000	0.4453	15.0000	0.4453
ζ	0.0567	0.0007	0.0567	0.0007	0.0567	0.0007	0.0567	0.0007
logLL	233.044	-	232.928	-	285.325	-	222.918	-

	Gabon	s.e.	Ghana	s.e.	Guinea	s.e.	Kenya	s.e.
β	0.1033	0.0006	0.1033	0.0006	0.1033	0.0006	0.1033	0.0006
ς_c	0.2954	0.1031	0.4797	0.1329	0.2934	0.2737	0.2234	0.0866
t_δ	15.0000	0.4453	15.0000	0.4453	15.0000	0.4453	15.0000	0.4453
ζ	0.0567	0.0007	0.0567	0.0007	0.0567	0.0007	0.0567	0.0007
logLL	201.421	-	223.228	-	215.602	-	195.464	-

	Liberia	s.e.	Nigeria	s.e.	Rep. of Congo	s.e.	Sierra Leone	s.e.
β	0.1033	0.0006	0.1033	0.0006	0.1033	0.0006	0.1033	0.0006
ς_c	0.8489	0.1830	1.9989	1.9396	0.4247	0.0805	0.5934	0.1510
t_δ	15.0000	0.4453	15.0000	0.4453	15.0000	0.4453	15.0000	0.4453
ζ	0.0567	0.0007	0.0567	0.0007	0.0567	0.0007	0.0567	0.0007
logLL	305.431	-	303.001	-	267.436	-	242.161	-

	Tanzan -ia	s.e.	Togo	s.e.	Uganda	s.e.
β	0.1033	0.0006	0.1033	0.0006	0.1033	0.0006
ς_c	0.1985	0.0355	0.2097	0.7527	0.3018	0.0463
t_δ	15.0000	0.4453	15.0000	0.4453	15.0000	0.4453
ζ	0.0567	0.0007	0.0567	0.0007	0.0567	0.0007
logLL	270.308	-	195.292	-	247.075	-

Notes: The logLL reported is specific to the contribution of the country.

Appendix Table A1b: Senior Ministers Maximum Likelihood Estimates

	Benin		**Camero -on**		**Congo Dem. Rep.**		**Cote d'Ivoire**	
γ for leader:	lower	upper	lower	upper	lower	upper	lower	upper
1	0.0042	0.0044	0.0026	0.0026	0.0010	1.0000	0.0022	0.0023
2	0.0000	0.0039	0.0026	0.0026	0.0011	1.0000	0.0000	0.0022
3	0.0039	1.0000	-	-	0.0009	0.0009	0.0000	1.0000
4	0.0000	1.0000	-	-	0.0009	0.0009	0.0023	0.0025
5	0.0000	1.0000	-	-	-	-	-	-
6	0.0000	1.0000	-	-	-	-	-	-
7	0.0000	0.0039	-	-	-	-	-	-
8	0.0039	0.0042	-	-	-	-	-	-
9	0.0046	1.0000	-	-	-	-	-	-
10	0.0044	0.0046	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-

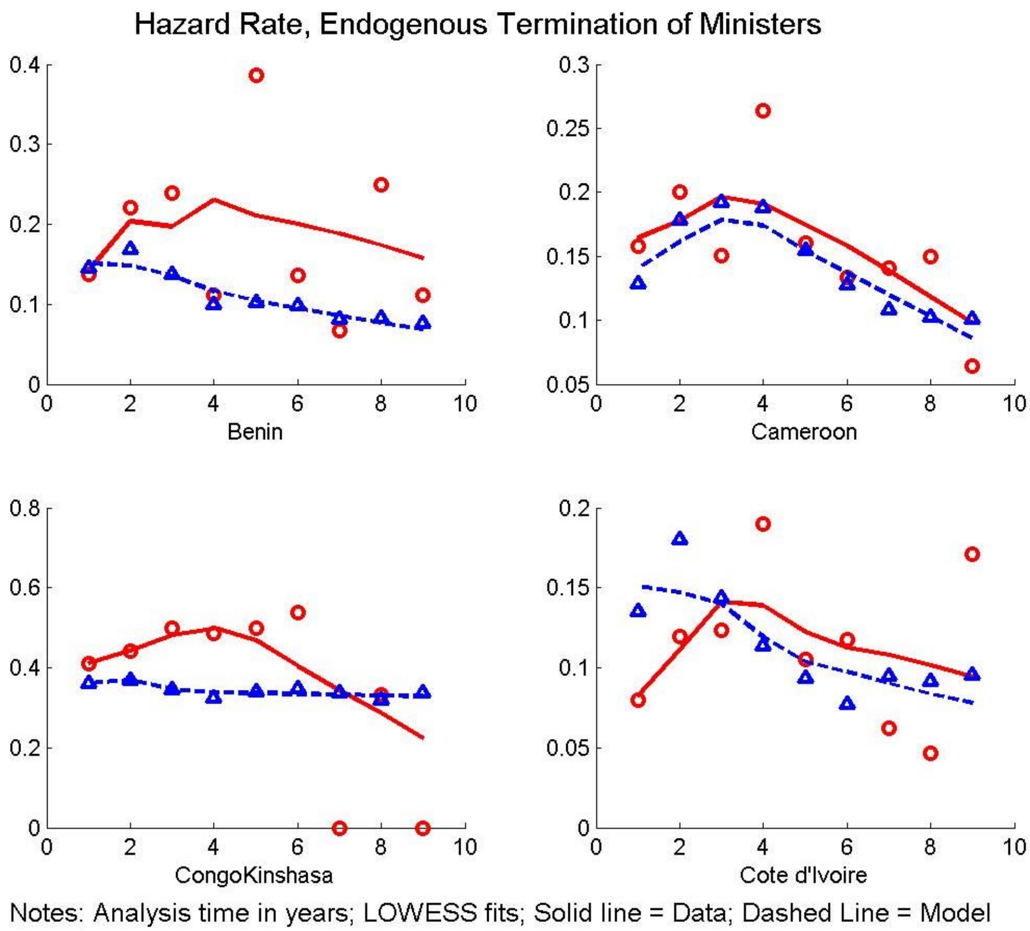
	Gabon		**Ghana**		**Guinea**		**Kenya**	
γ for leader:	lower	upper	lower	upper	lower	upper	lower	upper
1	0.0030	1.0000	0.0026	0.0028	0.0026	0.0027	0.0000	0.0025
2	0.0026	0.0027	0.0026	1.0000	0.0033	1.0000	0.0030	0.0031
3	-	-	0.0000	1.0000	-	-	0.0000	0.0025
4	-	-	0.0025	1.0000	-	-	-	-
5	-	-	0.0030	0.0031	-	-	-	-
6	-	-	0.0000	0.0025	-	-	-	-
7	-	-	0.0000	1.0000	-	-	-	-
8	-	-	0.0000	0.0025	-	-	-	-
9	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-	-

	Liberia		Nigeria		Republic of Congo		Sierra Leone	
γ for leader:	lower	upper	lower	upper	lower	upper	lower	upper
1	0.0000	0.0030	0.0000	0.0018	0.0031	0.0033	0.0000	0.0025
2	0.0030	0.0032	0.0000	1.0000	0.0037	1.0000	0.0000	0.0025
3	0.0035	0.0036	0.0018	0.0019	0.0041	0.0042	0.0000	1.0000
4	0.0000	0.0030	0.0000	0.0018	0.0000	0.0031	0.0000	0.0025
5	0.0000	1.0000	0.0000	0.0018	0.0000	0.0031	0.0025	0.0026
6	0.0000	1.0000	0.0000	0.0018	0.0037	1.0000	0.0028	1.0000
7	0.0000	1.0000	0.0000	0.0018	0.0031	0.0033	0.0000	1.0000
8	0.0032	0.0033	0.0000	1.0000	-	-	0.0000	1.0000
9	0.0000	1.0000	0.0018	0.0019	-	-	0.0029	0.0030
10	0.0000	1.0000	0.0000	1.0000	-	-	-	-
11	-	-	0.0000	0.0018	-	-	-	-

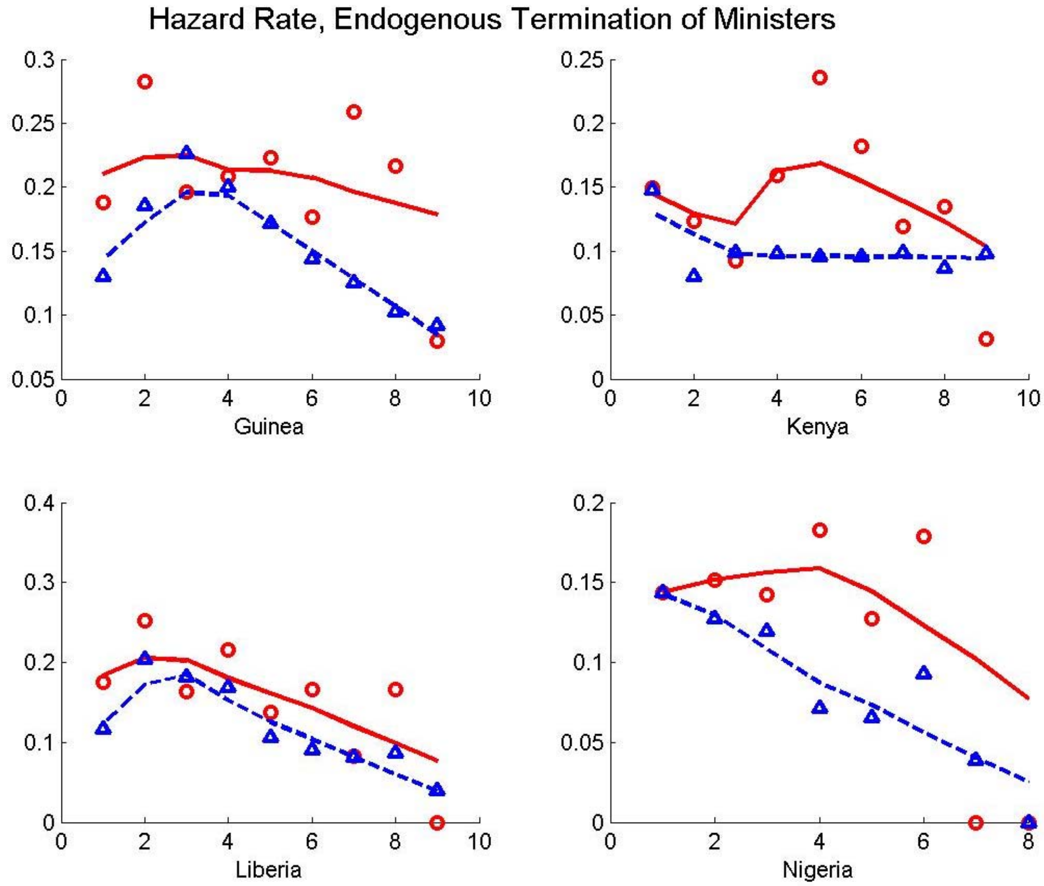
	Tanzania		Togo		Uganda	
γ for leader:	lower	upper	lower	upper	lower	upper
1	0.0032	0.0033	0.0037	0.0040	0.0028	0.0029
2	0.0031	0.0032	0.0037	0.0040	0.0032	1.0000
3	0.0030	0.0031	0.0053	1.0000	0.0000	1.0000
4	-	-	-	-	0.0000	1.0000
5	-	-	-	-	0.0000	0.0025
6	-	-	-	-	0.0030	0.0031
7	-	-	-	-	-	-
8	-	-	-	-	-	-
9	-	-	-	-	-	-
10	-	-	-	-	-	-
11	-	-	-	-	-	-

Notes: Upper and lower bounds for the probability of coup success are reported.

Appendix Figure A1a

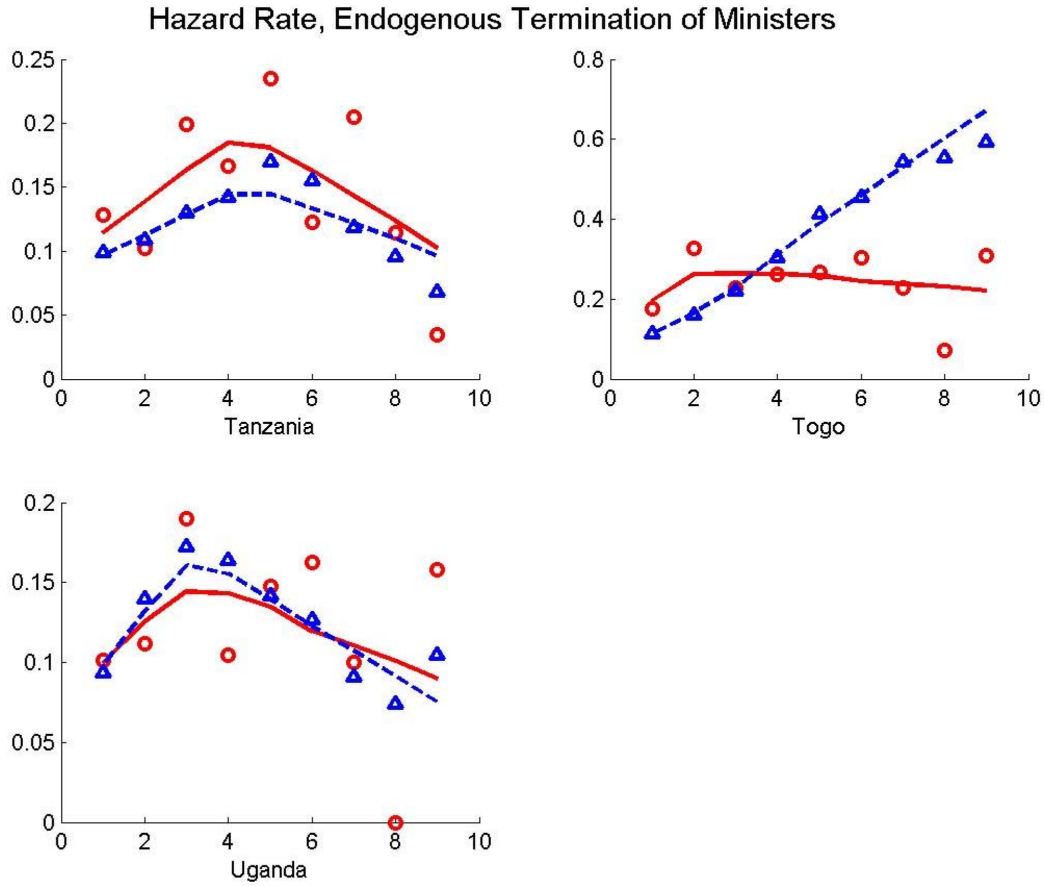


Appendix Figure A1b



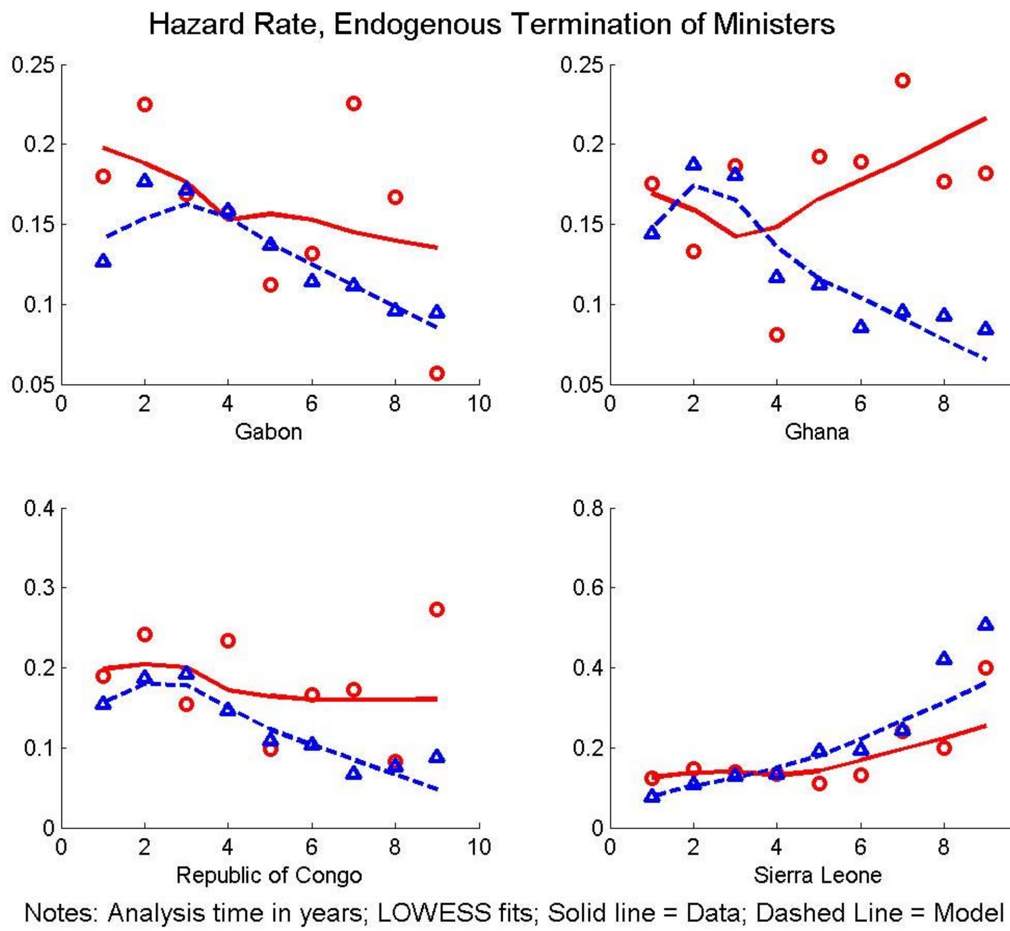
Notes: Analysis time in years; LOWESS fits; Solid line = Data; Dashed Line = Model

Appendix Figure A1c

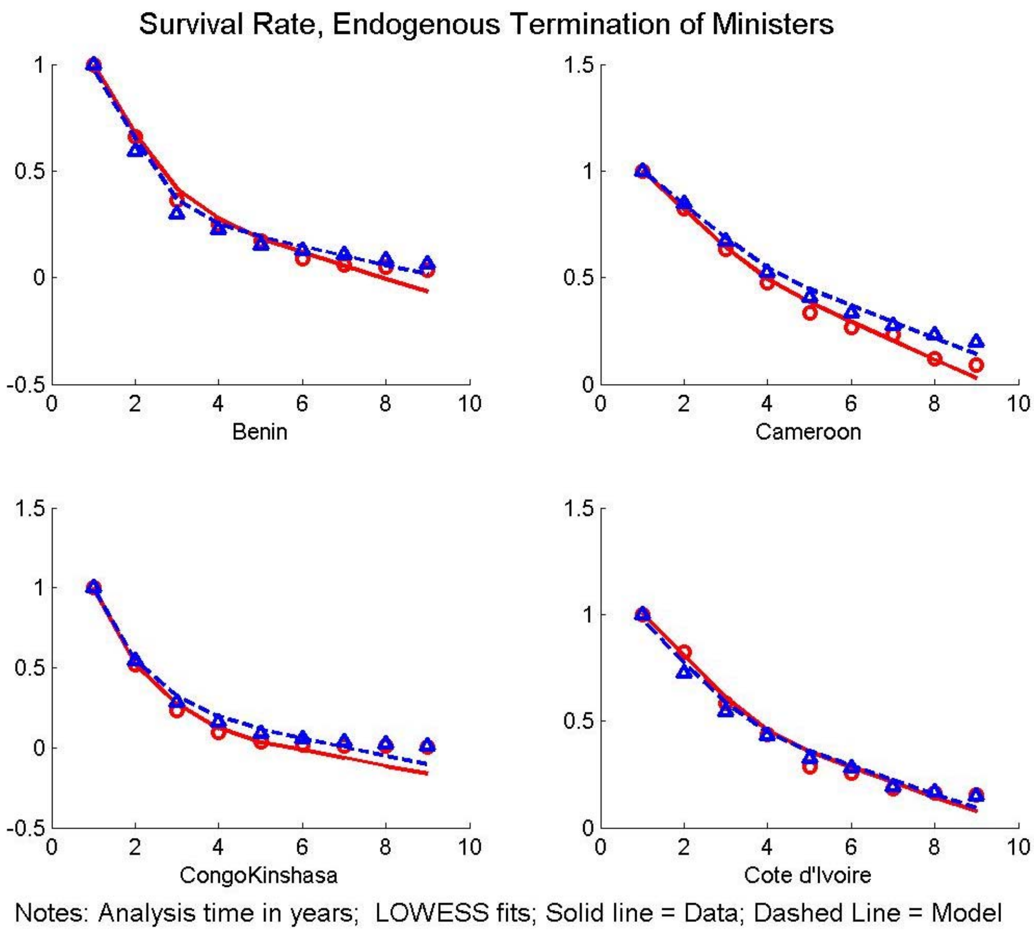


Notes: Analysis time in years; LOWESS fits; Solid line = Data; Dashed Line = Model

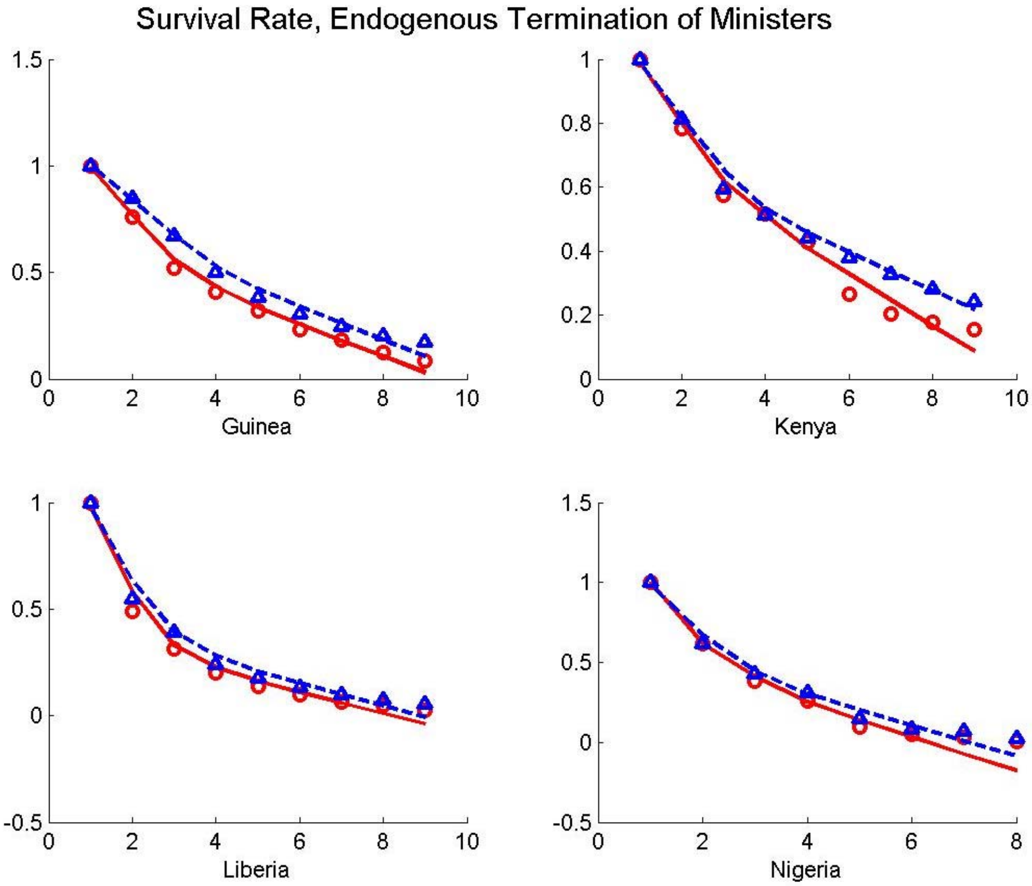
Appendix Figure A1d



Appendix Figure A2a

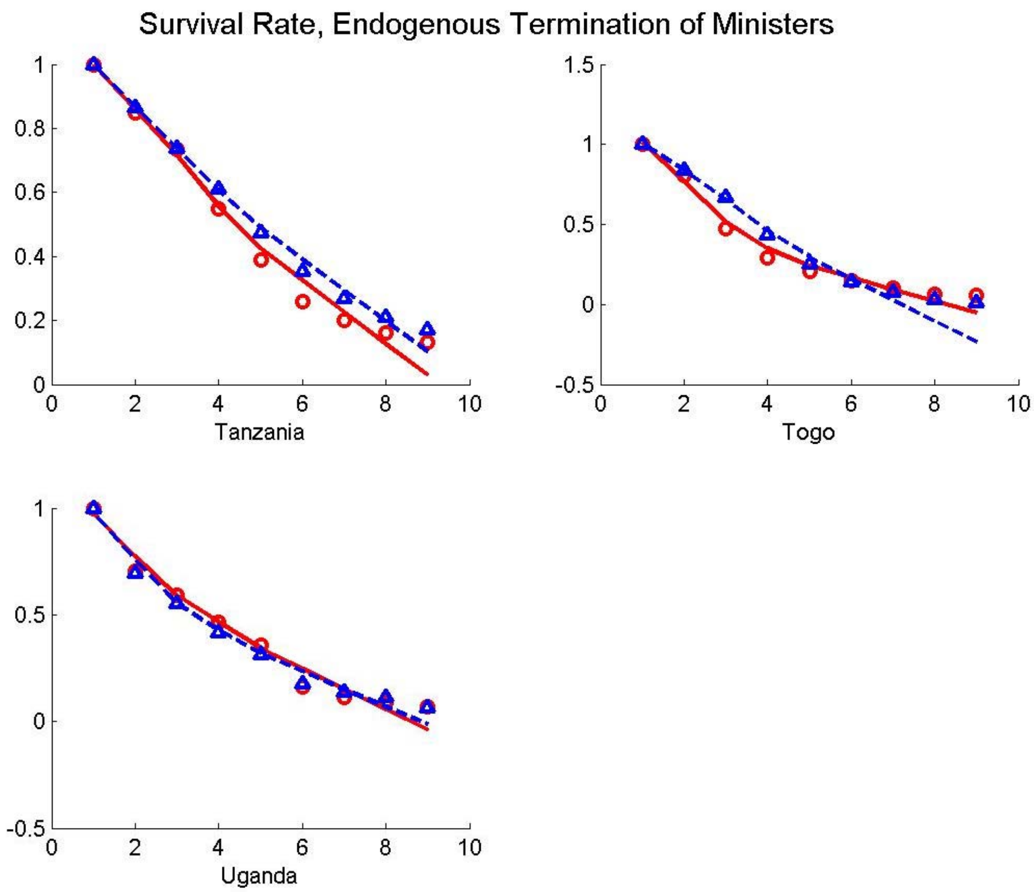


Appendix Figure A2b



Notes: Analysis time in years; LOWESS fits; Solid line = Data; Dashed Line = Model

Appendix Figure A2c



Notes: Analysis time in years; LOWESS fits; Solid line = Data; Dashed Line = Model

Appendix Figure A2d